SPEECH MONOGRAPHS

VOLUME IV DECEMBER, 1937 NUMBER 1

GRADUATE THESES—AN INDEX OF GRADUATE WORK IN THE FIELD OF SPEECH—III*

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THE third number of this index is designed to list the titles of theses studies completed during the year of 1936, to record the number of degrees granted without the requirement of thesis, and to supplement the record for other years with data not published previously.

Institutions for which titles are here listed for the first time include the University of Akron, Carnegie Institute of Technology, Grinnell, University of Missouri and Western Reserve University. Table I lists Western Reserve University as granting 34, and Yale University as granting 65 Master's degrees without the requirement of thesis. These degrees have been granted over a period of years. Thirty-three of the Western Reserve University degrees were Master of Arts in Dramatics and one a Master of Arts in Speech. The Yale degrees were all Master of Fine Arts. During 1936, Cornell has also granted a degree of Master of Fine Arts in Dramatics.

Institutions which granted the Doctor's degree in Speech for the first time in 1936 are Northwestern University and Ohio State University. Number 950 in this list from the University of Iowa is a Doctor's degree in Dramatics.

Table I lists the twenty-six institutions which have now granted graduate degrees in Speech. A total of 1833 Master's and 81 Doctor's degrees have been granted. Eight-hundred-eighty-six, or about 48 percent of the Master's degrees have been granted without require-

* To the many who have cooperated in the collection of these data the writer wishes to express appreciation. Suggestions as to methods of analysis which may make the data more useful will be gratefully received. Those wishing to consult the complete record of these studies should see articles by the same title, Numbers I and II, SPEECH MONOGRAPHS, 2, 1935, 1–49; 3, 1936, 1–20.

ment of thesis. These degrees have been granted, by five institutions; and with the exception of Southern California most of the Master's degrees at these institutions have been granted without thesis.

Table II contains an analysis of the major areas of subject matter in the field of Speech with which these theses have dealt. The table contains the number and percentage of the total for both Master's

TABLE I

INSTITUTIONAL SOURCES OF DEGREES GRANTED

	Master's Degrees				
	With Thesis	Without Thesis	Total	Doctor's Degrees	Combined Total
Akron	2		2		2
Carnegie	9		9		9
Columbia—Teachers College	3	429	432	7	439
Cornell	67		67	13	80
Denver	10		10		10
Geo. Washington	2		2		2
Grinnell	1		1		1
Illinois	4		4		4
Iowa	244		244	24	268
Louisiana	20		20	3	23
Marquette	13		13		13
Michigan		276	276	8	284
Minnesota	19		19		19
Missouri	1		1		1
New Mexico Normal	8		8		8
Northwestern	194		194	2	196
Ohio State	9		9	1	10
Ohio Wesleyan	25		25		25
Southern California	138	82	220	2	222
Stanford	6		6	1	7
Syracuse	3		3		3
Utah	12		12		12
Washington, University of	1		1		1
Western Reserve	1	34	35		35
Wisconsin	155		155	20	175
Yale		65	65		65
Totals	947	886	1833	81	1914

and Doctor's degrees in this list, as well as the list published in 1936 for comparison. Figures for the combined lists are also presented. The greatest number of Master's degrees granted has been in the field of Dramatics, with the other fields following in the order of Education, Public Address, Fundamentals, Pathology and Oral Reading. For Doctor's work, the greatest number of studies has been made in the field of Public Address, with Fundamentals, Dramatics, Pathology and Education following in the order named.

Section II of this report contains a list of the theses titles clas-

sified by institution, degree granted, year of granting the degree, and author's name alphabetically arranged within the year. The titles are given continuation numbers from last year's list, and begin with 880. Section III contains an index of the titles in this list classified according to the major fields suggested in Table II. Many of the titles are listed in more than one area.

TABLE II

DEGREES CLASSIFIED BY SUBJECT MATTER

			LAST LIST	NEW LIST	TOTAL
Fundamentals	Master's—	Number	77	11	88
		Percent	9.40	8.60	9.31
	Doctor's—	Number	13	7	20
		Percent	21.70	33.35	24.69
Public Address	Master's—	Number	150	14	164
		Percent	18.30	10.95	17.35
	Doctor's—	Number	21	4	25
		Percent	35.00	19.05	30.87
Reading	Master's—	Number	32	5	37
		Percent	3.90	3.90	3.90
	Doctor's—	Number			
		Percent			
Dramatics	Master's—	Number	342	58	400
		Percent	41.80	45.35	42.20
	Doctor's—	Number	7	5	12
		Percent	11.70	23.80	14.81
Speech Defects	Master's—	Number	60	13	73
		Percent	7.30	10.15	7.71
	Doctor's—	Number	8	3	11
		Percent	13.30	14.28	13.58
Education	Master's—	Number	139	27	166
		Percent	17.00	21.05	17.55
	Doctor's—	Number	7	2	9
		Percent	11.70	9.52	11.11
Miscellaneous	Master's—	Number	19		19
		Percent	2.30		2.01
	Doctor's—	Number	4		4
		Percent	6.70		4.94

SECTION II—TITLES

AKRON, UNIVERSITY OF

M.A. Theses

1932

880. Cox, H. Theodore, Eighteen Universal Standards of Dramaturgy Applied to Six Contemporary Plays.

881. Knight, Frances M., An Analysis of the Aspects of Radio Drama Which Differentiate it From the Legitimate Stage.

CARNEGIE INSTITUTE OF TECHNOLOGY

M.A. Theses

1917

882. McConnell, Frederic, "King Richard II," by Shakespeare (Prompt Book).

1930

833. Blank, Earl W., "The Thunderstorm," by Alexander Ostrovsky (Prompt Book).
884. Hickman, E. W., "The Wild Duck," by Henrik Ibsen (Prompt Book).
885. Shipman, Millard, "Zaragueta," by Miguel Ramos Carrion and Vita Aza (Prompt Book).

1931

886. Currie, Dean N., An Outline of an Elementary Course in Stage Lighting (Thesis part I), The Unit Set (Thesis part 2).
887. Dienes, Barnabas, "Two Cheeks to Slap" (Original Play).
888. Jackson, Phyllis, "A Scrap of Paper," by V. Sardou (Prompt Book).

1933

889. Sollers, John F., The Development of the Proscenium Arch (Research Problem), Designs for "The Farmer's Wife," "The Vultures," by Henri Becque (Prompt Book).

1934

890. Simonson, Ruth Jean, Considerations on Modern Stage Design (Research Problem), "The Adventurer," by A. Capus (Prompt Book).

COLUMBIA UNIVERSITY
Teachers College

Ph.D. Theses

1936

891. Kramer, Magdalene, Dramatic Tournaments in The Secondary School.
892. Leverton, Garrett, A Basis for Teaching the Production of Latter 19th Century American Drama.

CORNELL UNIVERSITY

M.A. Theses

1936

893. Conklin, Janet Frances, A Study of John Galsworthy as a Critic of English Society, Based Chiefly on Five of his Plays.

894. Fugler, Mary Margaret, The Principles of Expository Speaking.
895. Galligan, William Jay, Dramatic Structure and Problems of Presentation.
896. Kimball, Mary Osterbind, Expressionism in the Theatre.
897. Lombard, Edwin Henderson, The Japanese Theatre.
898. Metz, Ben, American Dramatic Criticism Centered in the Works of William Winter.
899. North, Joseph Henry, Period Influences in Acting.
900. Peltz, Annette Francis, Harley Granville-Barker: His Theory and Practice in the Theatre.

M.F.A. Theses

1936

901. Lewis, John Colby, Modern Theories of Dramatic Production Held by Jacques Copeau, Leopold Jessner, Alexander Tairov, Nicolas Evreinov, Vsevelod Meyerhold, Theodore Komisarjevsky.

Ph.D. Theses

1936

902. Fulton, Albert Rondthaler, Expressionism in Drama.
903. Moore, Arthur Ulric, Art, Community and Theatre, A Study of the Theories of Five Nineteenth Century Artists, Tolstoy, Wagner, Nietzsche, Appia, Rolland.
904. Tallcott, Rollo Anson, The Dramatic Art of Beaumont and Fletcher.

UNIVERSITY OF DENVER

M.A. Theses

1936

905. Huyck, Ethel, An X-ray Study of the Diaphragmatic Action Underlying Good and Poor Voices.
906. Jacobs, Bruno, Factors Responsible for Unsatisfactory Debate Decisions.
907. Redding, W. Charles, The Psycho-galvanometer as a Laboratory Instrument in the Basic Speech Course.

GRINNELL

M.A. Theses

1934

908. Stoaks, Florence L., Pedagogical Basis of a First Course in Speech.

UNIVERSITY OF IOWA

M.A. Theses

1936

909. Andersch, Elizabeth Genevieve, An Analysis of the Plays Commonly Presented by the Mid-Western High Schools.
910. Andrews, Kent, A Production and Prompt-Book of David Belasco's "The Return of Peter Grimm."
911. Barnett, Wynett, A Study of Dramatic Talent in X High School.
912. Beckey, Ruth Elizabeth, A Critical Study of Certain Exercises in Interpretative Reading Based on the Novel.
913. Berrier, Raymond Marvin, Symbolic Formulation and Expression in Speech with Special Regard to Vocabulary.
914. Black, Maleese May, A Director's Study and Designs for a Production in the Chinese Tradition of "Lady Precious Stream," by S. I. Hsiung.
915. Bunn, William Lewis, A Project in Stage Design for an Early Eighteenth Century Play: "The Mourning Bride" of William Congreve.
916. Clay, Leland Homer, A Director's Study and Designs for a Production of Aeschylus' "Agamemnon."
917. Curry, E. Thayer, A Study of Differential Background Factors Possibly Accounting for Varying Levels of Achievement of Inter-Scholastic Debaters in the Finals of the Iowa High School Forensic League of 1935–36.
918. Curry, Ota Thomas, The Speech of Abraham Lincoln in Defense of the Rock Island Bridge in 1857.
919. Curry, Herbert La Vere, An Evaluation of the Debating Technique of John C. Calhoun in Representative Pro-Slavery Speeches, 1847–50.
920. Davis, Dorothy May, Dextrality Quotients of Seven-Year Olds in Terms of Hand Usage and Strength.
921. Davis, Frank B., A Critical Analysis of Richard Mansfield as Actor, and Director-Producer.
922. Dement, Frances, A Critical Study of Certain Exercises in Interpretative Reading Based on the Short Story.
923. Enslin, Berne William, The Argumentative Technique in Selected Forensic and Demonstrative Speeches of James Wilson, 1775–1788.

924. Galey, Ellen C., A Director's Study and Prompt Book of "London Assurance."
925. George, Geneva Pauline, A Critical Analysis of Sir James Mackintosh as a Forensic Speaker in the Trial of Jean Peltier.
926. Gould, William Steel, Pronunciation Drills for College Freshmen—Part II of a Joint Study.
927. Harmon, Loren Foster, A Director's Study and Designs for a Production of William Shakespeare's "The Merry Wives of Windsor."
928. Hart, M. Blair, A Director's Study and Designs for a Production of Thomas Kyd's "The Spanish Tragedy."
929. House, Enod Scoville, Certain Laterality Characteristics of Children with Articulatory Disorders.
930. Hulbert, William John, A Study in Improvement in Speaking Ability.
931. Jordan, Harold Monroe, An Evaluation of the Argumentative Methods of Daniel Webster in Four Representative Courtroom Speeches.
932. King, Edwin Joseph, A Preliminary Investigation of the Case Method of Instruction in a High School Course in Speech.
933. Kleibacker, Frederick Rawlings (Jr.), Three Original Plays, "Let There Be John Micheljohn"; "Lady Wildcat"; and "The King's Coat."
934. Lembke, Blanche Davis, Original Exercises in Pantomime.
935. Meredith, Lucile, Pronunciation Drills for College Freshmen —Part 1 of a Joint Study.
936. Miller, Marvel Garnant, A Director's Study and Designs for William Congreve's "The Way of the World."
937. Millsapps, Lucile Smith, The Role of Specific Words in the Distribution of Stuttering Moments During Oral Reading.
938. Mullen, Lois Gerry, The Oratorical Technique of Carl Schurz in the Campaign of 1860.
939. Oliver, Sister Mary Leola, A Prompt-Book and Production of Henry Gheon's "The Comedian."
940. Rietz, Louise Jean, The Stage on the Frontier Before 1880.
941. Robertson, Helen Edde, A Study of 14th Century English Costume and Its Adaptation for Theatrical Use.
942. Scott, Joseph Wright, A Director's Study and Designs for a Production of Shakespeare's "Henry IV," Part I.

943. Sinn, Arlien, Frequency of Stuttering with Expectation of Stuttering Eliminated.
944. Stemm, George Aloysius, "Within These Walls"; An Experiment in the Coordination of Religion and Drama.
945. Solomon, Anita, Frequency of Stuttering in Relation to Expectation of Stuttering.
946. Tucker, Lawrence E., A Director's Study and Designs for "The Frogs" of Aristophanes.
947. Webster, Mary J., An Objective Study of Expectation of Stuttering as a Factor in the Precipitation of the Moment of Stuttering.
948. Whitehand, Robert E., An Experimental Production of an Original Play Based on Materials from the Oklahoma Oil Fields: "Precious Land."
949. Zeller, Wilma Wyant, Augustin Daly, Director-Manager: His Contributions to the American Theatre.

Ph.D. Theses

1936

950. Conkle, Ellsworth P., Experimental Production of Three Original Long Plays About American Pioneers.
951. Hitchcock, Orville Alban, A Critical Study of the Oratorical Technique of Jonathan Edwards.
952. McCall, Roy Clyde, The Public Speaking Principles and Practice of Theodore Parker.
953. Moore, Wilbur Erwin, A Conditioned Reflex Study of Stuttering.
954. Morris, Delyte Wesley, Position as a Factor of Attentional Clearness in Relation to Stuttering.
955. Moser, Henry Michael, A Qualitative Analysis of Eye-Movements During Stuttering.
956. Talley, Charles Horton, An Experimental Study of Projection.

LOUISIANA STATE UNIVERSITY

M.A. Theses

1936

957. Cuthrell, Julia Elizabeth, Expressionism in the Writing of Modern Drama.
958. Johnson, Vera Yeteva, The Comparative Frequency of The Spellings of the Phonetic Elements: As Found in a Selected Word List.

959. Teer, Margarete, Galsworthy Drama: Theory and Practice.

Ph.D. Theses

1936

960. Idol, Harriett Ruth, A Strobophotographic Study of Southern Intonation.
961. Smith, Harley A., A Recording of English Sounds at Three Age Levels in Ville Platte, Louisiana.

MARQUETTE UNIVERSITY

M.A. Theses

1936

962. Mannix, Mabel, The Mutual Interdependence of Music and Speech in Secondary Education of the United States with a Plan of Correlation.
963. Mueller, Marjorie Anne, Propaganda as Used by the Soviet Government—Their Theatre Since the 1917 Revolution.

UNIVERSITY OF MICHIGAN

Ph.D. Theses

1936

964. Moses, Elbert R., Palatography—A Critical Study and Analysis of Sound Image Contacts.
965. Runion, Howard L., An Objective Study of the Speech Style of Woodrow Wilson.

UNIVERSITY OF MINNESOTA

M.A. Theses

1936

966. Arnold, Genevieve, The Validation of The University of Minnesota Speech Clinic Laterality Questionnaire.
967. Frey, Mabel M., The Junior Playmaker Organization of North Dakota.
968. Hansen, Edna. An Experimental Study of the Effect of Negative and Positive Argument on the Attitude of Listeners.
969. Hargis, Donald E., A Scale for Measuring Speech Attitudes.
970. Hjelmervik, Marjorie C., A Critical Comparison of the Idiom of Archer's Translation of "Pillars of Society" and a New Translation with the Original.
971. Hoyer, Esther, The Analysis of Some Speech Attitudes and Speech Experiences of High School Students.

972. Johnson, John Wendell, Prompt-Book and Production of "Charles II," by John Howard Payne and Washington Irving.
973. McGladry, L. D., The Changing Standards of Preaching as Revealed in the Lyman Beecher Lectures in Preaching from 1872 to 1935.

UNIVERSITY OF MISSOURI

M.A. Theses

1934

974. Bynum, Ruth E., The Use of Rhetoric in Carlyle's Political Pamphlets.

NORTHWESTERN UNIVERSITY

M.A. Theses

1936

975. Bergfald, Milburn, Productions of Shakespeare in Chicago, 1837–1857.
976. Bredlow, Lulu, A History of the German Theatre in Milwaukee from 1850 to 1935.
977. Brown, Helen Moore, The Account of an Experiment Showing the Effect of a Year's Work in Creative Dramatics on a Group of Problem Children.
978. Browne, Jeane Elmira, A Check List of Women's Style Trends for 1890 to 1895, with Patterns to Scale and Fabrics for Their Use on the Stage.
979. Clasen, Gratia, An Interpretative Analysis of Keat's "The Eve of St. Agnes."
980. Coutts, Wesley Alan, "Wharf Song," An Original Play in Three Acts.
981. Crawford, Gene, An Analysis and Evaluation of George Lansing Raymond's "Orator's Manual."
982. Eccles, Dorothy, A Study of Various Means of Stimulating the Imagination of the Oral Interpreter.
983. Garvey, Helen, Costumes Designed and Patterns Executed for School Production, Representing Scenes from Shakespeare in Four Periods of Dress.
984. Goe, Ida Mae, A Check List of Women's Style Trends for 1860 to 1865, with Patterns to Scale and Fabrics for Their Use on the Stage.
985. Hicks, Mason, A Production of Tom Taylor's "The Ticket of Leave Man."

986. Hill, Florence, Experiments with the Oral and Written Methods of Teaching Medieval History, European History, and American Literature.
987. Hilts, Ivamae Small, An Interpretative Study of George Eliot's "Ramola."
988. Ives, Almon B., The Interpretation of Tennyson's "Launcelot and Elaine."
989. Jerome, Eldon King, A Comparison of Adolescent Males Undergoing 'Change of Voice' as to Chronological, Mental, and Skeletal Ages.
990. Keach, Stacy, A Reproduction of David Belasco's "The Girl of the Golden West."
991. Martin, Kathryn Brewster, Augustus Thomas: Dramatist.
992. Mitchell, Lee, The Use of Elizabethan Weapons in the Staging of Shakespeare's Plays.
993. Read, Marian, The Selection and Production of Three One-Act Plays by George Bernard Shaw Appropriate to Use in Secondary Schools.
994. Robertson, Kathleen, Methods of Exposition of Antecedent Action in Shakespeare's Plays.
995. Rucker, Ruth, Woodrow Wilson's Concept of American Principles as Revealed in the Speeches on His Western Tour, September 4–25, 1919.
996. Snyder, Mary, An Interpretative Study of Rosalind in William Shakespeare's "As You Like It."
997. Sullivan, Helen Britton, An Experimental Study in the Teaching of Dialect.
998. Terrell, Doris, A Study of Elizabethan Staging and the Design of a Unit Set for the Production of Three Shakespearean Comedies.
999. Willson, Loretta Lyle, A Survey of Dramatic Productions on the Legitimate Stage in Sioux City, Iowa, 1870–1919.
1000. Youngquist, Edna Victoria, A Production of Synge's "The Playboy of the Western World."
1001. Zeitlin, Rosalyn R., Hypnotherapy in Stammering.

Ph.D. Theses

1936

1002. Carhart, Raymond Theodore, Infra-Glottal Resonance and a Cushion Pipe.

1003. Moore, George Paul, A Stroboscopic Study of Vocal Fold Movement.

OHIO STATE UNIVERSITY

M.A. Theses

1932

1004. Mason, Marie K., Barbaralalia Phenomena in Visual Hearing.

1933

1005. Voelker, Chas. H., Phonetic Distribution in Formal American Pronunciation—A Study of the English of Radio Announcers.

1935

1006. Gordon, Margaret, An Analytical Comparison of the Speech Tempo of Deaf and Hearing Individuals.

1936

1007. Ager, George S., The Future of Word Consciousness.

1008. Hill, Maceo, A Spirometric Study of Speech and Voice.

Ph.D. Theses

1936

1009. Cotton, Jack C., A Study of Certain Phoniatric Resonance Phenomena.

OHIO WESLEYAN UNIVERSITY

M.A. Theses

1936

1010. Domigan, Maxine, Status of Teaching of Speech in the Universities and Colleges of the United States.

UNIVERSITY OF SOUTHERN CALIFORNIA

M.A. Theses

1936

1011. Kendall, Lois Fae, Critical Analysis of Specific Works of Five Leading Authorities in the Field of Interpretation.

1012. Leonard, Marion Van Loon, Oral Monologues of Early California Life, Based on Historical Research.

Ph.D. Theses

1936

1013. Weisslingen, Kurt Baer von, An Historical Survey of the Social Aspects of the William Tell Legend as Expressed in the Drama.

SYRACUSE UNIVERSITY

M.A. Theses

1936

1014. Hutchison, Elizabeth Lewis, A Comparative Study of Twenty Children with Specific Speech Defects.

WESTERN RESERVE UNIVERSITY

M.A. Theses

1932

1015. Troesch, Helen D., Director's Manuscript for the "Knavery of Scapin."

UNIVERSITY OF WISCONSIN

M.A. Theses

1936

1016. Anderson, Martin Perry, Constructing Attitude Scales for Use in Speech Situations.
1017. Boyer, Martha May, An Annotated Bibliography of Assembly and Auditorium Practice in Elementary and Secondary Schools.
1018. Bulgarelli, Sister Mary La Verne, St. Francis of Assisi, The Medieval Orator.
1019. Foure, Jacqueline H., A Study of Mongolism as Viewed by a Student of Speech Pathology.
1020. Madden, Margaret D., Savonarola—The Orator.
1021. Rezek, Clarence, Theodore Parker, A Study in Persuasion.
1022. Studebaker, Rowena, Attitudes Toward War as Revealed by Plays Presented on Broadway from 1914–35.
1023. Youngerman, Henry C., American Thesis Drama on Broadway Between 1918 and 1936.

M.S. Theses

1936

1024. Chaimson, Ruth E., Teaching Oral Language by Model and by Rule.

Ph.M. Theses

1936

1025. Conger, Maybelle W., Poetry for Use in Children's Reading.
1026. Crawford, Paul K., The Rise of the Reverend Charles Edward Coughlin, Radio Speaker.

1027. Schuster, George, Diabetes Mellitus and Epilepsy Viewed from the Standpoint of Dysphemia.

Ph.D. Theses

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1028. Bauer, Marvin, Henry Grady, Spokesman of the New South.

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Akron, University of	880— 881
Carnegie Institute of Technology	882— 890
Columbia University—Teachers College	891— 892
Cornell University	893— 904
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PUBLIC LIBRARY

THE ETIOLOGY OF SOUND SUBSTITUTION DEFECTS

BY JAMES CARRELL [1]

Mooseheart Laboratory for Child Research
and Ohio State University

IN AN earlier study[2] the writer has reported results of an attempt to discover possible etiological factors in that type of defective speech which is characterized by the substitution of improper phonetic units in the oral use of language. A group of such speech defective children was found to be slightly inferior to the general school population of which it was a sampling in intelligence (Kuhlman-Anderson) and school achievement (Stanford Achievement Test). The speech defectives were also inferior to a control group, matched on the basis of age, intelligence, and sex, in physical status as reflected by anthropometric measurements, and auditory acuity as measured by the Western Electric 4-A audiometer.

The present research is concerned with an extension of the earlier study to include a comparison of the speech defective and control groups on the basis of (1) ability to discriminate between phonetic units, (2) certain motor capacities as measured by (a) tapping and tracing tests, and (b) that motor capacity measured by the "tensiometer." Statistical analysis is made of the results of this and the earlier investigation in an effort to complete the clinical "picture" of the child having a sound substitution speech defect.

As in the earlier study, a group of 61 children having sound substitution defects served as subjects. This experimental group was divided into two sub-groups. Group 1 (41 cases) contained children whose speech was characterized by the habitual use of three or more sound substitutions. Group 2 (20 cases) contained subjects habitually using one or two characteristic phonetic transpositions.

[1] The writer did this research as a member of the staff of the Mooseheart, Illinois, Laboratory for Child Research and special thanks are due its director, Dr. Martin L. Reymert, for suggesting the study and for constant assistance and advice. Thanks are also due other members of the Mooseheart staff for their splendid cooperation.

[2] Carrell, J. A., "A Comparative Study of Speech Defective Children," *Arch. of Speech*, I, 1936, No. 3, 179–203.

Each child in the experimental group was matched with a control child on the basis of age, sex, and intelligence (Kuhlman-Anderson).

1. Auditory Factors in Sound Substitutions

The hypothesis underlying an association of sound substitution defects with auditory disorders holds that the child may confuse in his speech sounds which are not correctly perceived. This confusion might result first from decreased auditory acuity which would render certain phonetic elements unintelligible. A second possibility might be failure of the defective speaker to discriminate between phonetic units when auditory acuity falls within the normal range.

It has been shown earlier that sound substitution cases are deficient in auditory acuity, and we are led to these questions: (1) Are speech defective children generally inferior in their ability to discriminate between phonetic units? (2) Do children whose speech is characterized by sound substitutions fail specifically to discriminate between correct sounds and the incorrect sounds which are chosen as substitutes?

A study by Travis and Rasmus[8] furnishes data upon these questions. To 548 subjects, 165 having "mild functional speech disorders," the remainder normal speakers they gave a discrimination test using for comparisons all of the consonants and certain consonant blends and vowels. At every age level studied individuals with mild functional disorders of articulation made significantly more errors in discrimination than normal speakers. The mean number of errors for the adult defective group was larger than for any of the groups of normal children. The defective speakers did not miss any sounds consistently, but they did miss a larger number. Sixty-three percent of the pairs missed by 20 subjects having severe speech defects contained sounds with which these cases had articulatory difficulties.

The correlation with intelligence in the case of defective speakers was .044 p.e. $\pm$ .100.

The findings of Travis and Rasmus indicate a clear relationship between inability to make auditory discriminations of phonetic units and speech defects of the type studied. Not only do their data show the marked superiority of normal speakers in this capacity, but they

[8] Travis, L. E., and Rasmus, B. J., "The Speech Sound Discrimination Ability of Cases with Functional Disorders of Articulation," *Quarterly Journal of Speech*, 17, 1931, 217–226.

also suggest that the defective speaker tends to fail in discriminating those sounds with which he has difficulty. The extent to which this inability to discriminate may be attributed simply to a loss of auditory acuity cannot be deduced, of course, from their findings.

A. Procedure

The determination of the phonetic discrimination ability of the experimental and control groups in the present research was based upon the methods used by Travis and Rasmus, with certain important variations.

First, the paired sounds were presented by means of phonograph plates. This means of testing was adopted in an effort to secure standard conditions. For the experimenter to speak the paired sounds identically at different test sessions would be extremely difficult, hence the results of different tests might not be comparable. The fact that several experimenters participated in the research might also complicate the interpretation of the results.[4]

In our test 30 sounds (21 consonants and 9 vowels) were used. They were:

Consonants	*Vowels*
p, b, t, d, g, k, f, v, th (voiced and unvoiced), sh, zh, w, r, l, m, n, ng, s, z, j.	i:, e, æ, a:,):, ʌ, u:, u, i.

When consonants are compared with consonants, and vowels with vowels, a possible 210 combinations are found. For the purpose of our examination, 100 combinations were selected, and recorded. Those which are most frequently confused in sound substitution defects were included first. They are: s-th, z-*th*, w-r, f-th, v-*th*, t-k, d-g, b-v, w-l, t-s, t-th. In 30 cases identical sounds were given in pairs. The remaining pairs in the test series constitute a random sampling of the possible combinations. In recording, the vowel (a:) was added to each consonant to facilitate pronunciation and an effort was made to keep the factors of pitch, intensity, and inflection constant.

While this examination was not as complete as that of Travis and Rasmus, the sounds most often confused are included. The scat-

[4] It must be noted, however, that the objection suggested above may not be valid. The reliability co-efficient was fairly high (.71) in the study of Travis and Rasmus. The significance of the reliability co-efficient might be enhanced by the very fact that the test was given by different persons at different times with, inevitably, some difference in the manner in which the sounds were spoken.

ter with respect to the pairs missed in their examinations suggested that a random sampling of the remaining sounds would be satisfactory for test purposes.

The subjects were tested in groups of eight. Since incidental noises were unavoidable, care was taken to test each experimental subject and his control at the same session. Preliminary to the actual test, each child was shown individually the order in which the blanks were to be filled in. Five practise trials were given in which the examiner spoke pairs orally. After each practise pair, the subjects were asked to give their judgments orally, and to report whether they would write "s" (same) or "d" (different) on their papers.

In only three cases was it found necessary to give additional instructions. Furthermore, most of the children at the younger age levels were able to meet the test conditions satisfactorily.[5]

B. Results

(1) *Comparison of test scores.* Analysis of the test scores shows that the control group is superior in its ability to make auditory discriminations. (See Table I.) The mean number of errors in the case of control group I was 7.6, while the average of the experimental group was 11.1—the difference of the means being 3.5. The critical ratio of this difference was 2.8, which warrants the assumption of a fair degree of statistical reliability for these results. As will be seen from Table I, Groups II do not differ substantially. Here the mean difference is less than one error (.3) and the critical ratio only .5. Taken as a whole, the experimental group is inferior to the control group by a mean difference of 2.4 errors, critical ratio 3.8.[6]

One may infer from these data that, as a class, the speech defective children studied were somewhat inferior to normal speaking children with respect to their ability to discriminate between phonetic units. It will be remembered, however, that the speech defectives were also found to be deficient in auditory acuity. The correlation coefficient between auditory acuity (speech loss) as determined by the 4-A audiometer and the phonetic discrimination test was found to be .60, p.e. $\pm$ .01. The reliability of the phonetic discrimination test was found to be .79, p.e. $\pm$ .01.

[5] This was also found true in the study of Travis and Rasmus.

[6] The higher statistical reliability when the entire groups are considered arises, of course, from the fact that more cases are considered in the computations.

It would not seem reasonable to infer that scores on the phonetic discrimination test were not determined substantially by auditory acuity. There appears to be, however, some additional factor operative. Whether this additional factor is a "special" inability to make discriminations, or whether it represents some form of instability in the test performance of these subjects having speech disorders cannot be determined from our data.

Our test results do not indicate as clear a differentiation on the basis of the phonetic discrimination test between normal and speech defective subjects, as in the study by Travis and Rasmus. At every age level, their normal subjects were significantly superior to the speech defective cases. In our data, however, groups II do not differ significantly. Explanation of this disparity is difficult. However, Travis and Rasmus examined a larger number of cases than in the present research, and employed different test methods. Further, their speech defective cases included other than sound substitution defects.

Intensity differences in the stimulus series used in our examinations and those of Travis and Rasmus might explain the discrepancy in the reported results, and it is unfortunate that no exact measurement of these possible differences can be made. Our tests were made at a level of loudness which probably placed the sounds well above the auditory threshold in every case. It is therefore probable that the performance of the normal and speech defectives would have been more clearly differentiated if the intensity of our sounds had been more attenuated.

(2) *Analysis of sounds missed on the phonetic discrimination test.* It was thought that an analysis of the phonetic discrimination test might yield more significant data than the simple enunciation of test scores. Following are the crucial lines of inquiry: (1) Which sounds are most frequently misheard? (2) Which *pairs* of sounds are most difficult to discriminate? (3) Is there any positive relationship between the individual sounds misheard and those *pairs* of sounds confused, and the phonetic units involved in sound substitution defects?

A study by Fletcher[7] gives some evidence on the relative ease with which sounds are heard. He employed two methods: (1) *the method of articulation,* in which key words were called to observers, and (2) the *method of attenuation,* in which the relative phonetic

[7] Fletcher, Harvey, *Speech and Hearing,* New York: D. Van Nostrand Company, 1929.

power of fundamental speech sounds was measured in terms of the number of decibels by which a sound must be attenuated to render it unintelligible. Following is a summary of his results:

Sound	Percent of Times Misinterpreted	Sound	Relative Phonetic Power
th	17.3	th	1
f	12.7	f	5
v	3.9	p	6
e	2.8	d	7
p	2.5	b	7
u	2.5	*th*	11
u:	2.2	v	12
k	1.8	k	13
s	1.8	g	15
æ	1.5	t	15
sh	1.5	s	16
i:	1.2	zh	20
n	1.1	l	100
b	1.1	r	210
):	1.1	):	680
g	1.0		

Certain interesting comparisons are possible between the data from the phonetic discrimination test and Fletcher's compilations. In our test the sounds most difficult to hear are (in rank order): v, th, b, f, *th*, z, t, sh, m, d, g, p, r, w. Of these, the following were found difficult on Fletcher's articulation test: v, f, b, *th*, g, sh, p, b. (The sound th apparently was not included in the articulation test.) The sounds s and m were frequently confused in our test, but not in Fletcher's. In the determination of relative phonetic power (*method of attenuation*), 11 sounds having lower phonetic power also appear on our list of 15 sounds most frequently misheard. They are v, *th*, b, th, f, z, t, zh, d, p, g, r. There is a disagreement on the sounds sh, w, m, and s.[8]

From an inspection of Tables IV and V it may be seen that certain sounds which are both frequently *avoided* and *preferred* (substituted for the correct sound) in sound substitution defects were found to be misheard by a large percentage of subjects. Sounds frequently avoided that are also misheard are z, th, *th*, sh, v, and t, while f, t, v, th, *th*, and b are both frequently preferred in substitutions and also misheard.

The pairs of sounds most frequently involved in substitutions

[8] It must be noted that Fletcher used meaningful words, containing the key sound, and that for this reason identification of the correct sound from its context might frequently be made. Such identification would, of course, be impossible in our examinations.

(see Table VI) were th-f, *th*-v, b-v, z-*th*, and f-v. All of these sounds, with the exception of z, are low in audibility according to Fletcher's determinations, while they were also missed by a substantial percentage of subjects on the phonetic discrimination test.

While the evdience thus far presented seems to suggest that speech defectives misinterpret and fail to make correct discrimination involving those sounds with which they have articulatory difficulty, there is nevertheless a considerable mass of evidence which might conflict with this viewpoint. First, the pairs f-th and *th*-v, were missed by almost as many normal as defective subjects on the phonetic discrimination test, while the defective group was actually superior on the pairs t-k and th-s.

Second, certain frequent substitutions are not frequently confused on the phonetic discrimination test. They are d-g and w-l. Finally, the sounds r, w, and s which occur frequently in sound substitutions were found to have relatively high audibility.

It therefore appears that certain sounds confused and misheard by the speech defectives are those with which they have articulatory difficulty. On the other hand, many normal speakers commit similar auditory errors, yet no speech defect results. Certain sounds difficult to hear are involved in sound substitutions; yet certain other sounds found in sound substitutions were not found acoustically difficult. Certain difficult sounds involved in substitutions are misinterpreted with almost equal frequency by the experimental and control groups.

To reconcile this conflicting evidence is somewhat difficult. A first possible interpretation might be that the manner in which the sounds were presented in the phonetic discrimination test was peculiar in that they were spoken in such a way as to be either easy or difficult to understand. The substantial agreement between our findings and those of Fletcher would seem to argue against this conclusion. A second line of reasoning might be that if our basic hypothesis is true, i.e., that faulty discrimination leads to sound substitutions, it need not necessarily follow that the normal speakers are superior in this respect. It may well be that a defective speaker will detect differences in sounds spoken by others, but fail to make a discrimination when those same sounds are employed in his own speech. The speech teacher commonly meets cases who are not aware of their own defects, but who can detect similar conditions in others. If this line of reasoning is taken, it will then be necessary, however, to seek

the critical factor which leads to a sound substitution defect in one child and not in another when both make faulty discriminations. Deficient motor ability, unsuitable speech models, or chance attention factors might conceivably supply this factor.

In summarizing the phonetic discrimination data, certain conclusions seem warranted. First, the control group is superior in phonetic discrimination. Second, there is no close relationship between auditory acuity and discrimination ability. Third, a high percentage of the sound substitutions may be explained on the basis of acoustic properties which make them difficult to perceive and discriminate; those involving the sounds v, *th*, th, b, p, f, v, d, t. These sounds are, in general perceived more accurately by normal speakers —but the degree of this superiority varies. Those substitutions involving the sounds r, w, s, cannot, on the basis of the data given here, be attributed to acoustic factors.

2. Motor Tests

Speech is a function which requires finely organized motor co-ordinations. The hypothseis might be made that lack of co-ordination in these articulatory mechanisms which are movable and whose correct adjustment is essential to normal speech might serve to prevent the correct learning of phonetic units or sounds.

A study by Wellman[9] and others has suggested the possibility of some relationship between motor ability and speech ability. In their study two measures were used: first, a tracing path test of motor control which yielded a correlation coefficient of .67 (p.e. $\pm$ .06) between this test and ability to produce consonants and consonant blends. A second measure, the perforation test, indicated a correlation of .52 (p.e. $\pm$ .09) between this measure and the number of consonant sounds correctly spoken. As the authors point out, however, the groups tested consisted of children ranging from two to six years in age and both motor ability and speech ability increase with age; hence, this relationship might be substantially reduced if the determinations were made within a narrower age range.

A comparison of the experimental and control groups was undertaken on the basis of certain simple motor tests: (1) performance on the Scripture-Reymert tensiometer, (2) tracing, and (3) tapping.

[9] Wellman, B. L., Case, I. N., Mengert, I. G., and Bradbury, D. E., "Speech Sounds in Younger Children," *Univ. of Iowa Studies in Child Welfare*, 5, 1931, No. 2.

A. Tensiometer Findings

(1) *Apparatus and Procedure.* The Reymert "tensiometer" is designed as a motor test involving "kinaesthetic imagery." The apparatus consists of a movable plunger, opposed by a spring, which the subject is instructed to draw back a standard distance while blindfolded and after practice attempts. During the practice efforts a check is so arranged that the plunger is stopped when it has been pulled the standard distance. Degree of error in the test pulls is measured in terms of millimeters on either side of zero, which is placed at the standard distance. Subjects are directed to use cues of muscular tension as the criteria determining the duplication of the standard "pull."

(2) *Results.* Data gathered in the tensiometer examinations are presented in Table VII. An analysis was made on the basis of performance with the right arm, left arm, and the average of the two. In every case the figures represent the average of the deviations of the ten test pulls from zero, expressed in terms of millimeters. No improvement attributable to practice was observed in an analysis of the performance of a sampling of the subjects. The coefficient of reliability was found to be .71.

A summary of the results of the tensiometer examination (see Table VII) shows that in all cases the control group is superior to the experimental group, and the discrepancies greater when groups I are considered. As will be seen from Table VII, these differences are small, the greatest being 4.4 mm., but the results may be considered statistically reliable.

Assuming the validity of the tensiometer examinations, certain interesting suggestions may be made. This apparatus, presumably gives a measure of the subject's ability to reproduce certain motor adjustments. In learning speech sounds, precisely this ability is required—although other factors are present. The infant must be able to effect muscular adjustments of his articulatory organs in such a way that the sound produced is identical to the "model" sound as he hears it spoken by others and in a manner comparable to his own previous successful efforts. In this case, the process probably takes place below the level of consciousness. Older children whose speech is being re-educated, however, often are required to give conscious attention to those muscular adjustments of the tongue and other articulatory organs which are necessary for the correct production of the sound in question.

It would seem safe to assume that, whether consciously or uncon-

sciously, speech sounds are learned partly on the basis of kinaesthetic "cues." Therefore, lack of ability to act upon these cues might lead to the type of disfunctioning characteristic of speech defects of the type being studied. Whether or not this lack involves deficient "kinaesthetic imagery" or "muscle memory" cannot be determined by our data, but the general inference that an apparatus patterned after the tensiometer may yield results of considerable diagnostic value would appear to be justified.

B. Tracing

A simple tracing test was next given as an index to motor ability. For this purpose the tracing test employed as part of the Detroit Mechanical Aptitude test was selected. This is a "paper and pencil" test consisting of a labyrinth in the channels of which the subject is to draw a line without touching the sides. Scores are determined by the number of sections traversed without touching the sides, in a given time. Standard instructions used in the Detroit Mechanical Aptitude test were also employed for this examination. Success in this test is reflected by a high numerical score.

Such a test as this clearly involves "eye-hand" co-ordinations. This section of the motor-test battery therefore involves no co-ordinations which may be considered directly important for speech. It was hoped, however, that this examination and the "tapping test" would afford some insight into the general motor capacity of the subjects and provide some basis for the comparison of the experimental and control groups with respect to this capacity.

Results of the tracing test are given in Table VIII. The data furnished by this examination are somewhat equivocal in nature. A comparison of groups I indicates that the control group is superior in that capacity measured by the tracing test. The mean difference between the two groups was 2.06, the standard error of the difference .67, and the critical ratio 3.07. In the case of groups II, however, the experimental group was superior in performance to the control group, the mean difference here being 1.78, standard error of the difference .89, critical ratio 2.0. When the entire experimental and control groups are considered, the control groups appear superior, but this difference has low statistical reliability. Specifically, the mean difference is .62, the standard error of the difference .78, and the critical ratio .79.

As in the tensiometer, the absolute difference is small; more so here, perhaps, than in the case of the tensiometer. The most signifi-

cant difference between the defective and non-defective children is found in the case of groups I, but here the absolute difference in scores is only 2.6. The tendency for the disparity of the groups to be more severe when the more seriously defective children are considered, which has been shown to exist in other measures, persists here. Considered as a whole, the experimental and control groups do not differ significantly. At best, these data warrant only the conclusion that the normal children tend to be slightly superior in the capacity tested.

C. Tapping

Experimental and control subjects were then examined by means of a simple "tapping" test. The conventional apparatus was used, consisting of an electric counter actuated when an electric circuit is closed by touching a stylus point to a metal plate. In every case the subjects were given a one minute practice trial to acquaint them with the nature of the test, and three test trials with each hand. The duration of each trial was one minute. Care was of course taken that substantially the same movement (i.e. wrist movement) was employed by all subjects and the order of hands was systematically varied. The score for each hand represents the average of three trials. (See Table IX.)

When data for the right hand were analyzed, it was found that the difference between groups I was 7.0 taps. The standard error of this difference was 2.3 and the critical ratio 3.0, a finding which indicates that this difference is statistically reliable. The mean score of groups II was identical (150). The mean difference of the entire experimental and control groups was 6.0, in favor of the control group, standard error of the difference 2.2, and critical ratio 2.72.

The results when the left hand is considered are substantially the same. In groups I, the difference of the mean score was found to be 9.0, standard error of the difference 1.9, critical ratio 3.7. Here the difference is slightly larger and the critical ratio is somewhat greater than in the case of the right hand. Groups II do not differ significantly, since the mean difference is only 1.0, the standard error of the difference 2.9, and the critical ratio .34. Averaging the entire experimental and control groups gives a difference 1.7, critical ratio 2.9. Here again the differences may be considered statistically reliable, excepting in the case of groups II.

The average scores (right and left hand) do not differ significantly from those on individual hands. In groups I, the mean differ-

ence is 8.0, standard error of the difference 2.5 and critical ratio 3.20. Groups II are not markedly different. The difference of the mean scores is only .5, the standard error of the difference 2.9 and the critical ratio .17. The entire experimental and control groups differ by 6.5, in favor of the control group, in their means, the standard error of the difference is 2.4, and the critical ratio is 2.70.

We may infer from these data that, as a group, the speech defective children are inferior to normal children in those motor capacities tested by "tapping." As in previous motor tests, the absolute differences are not sufficiently great to serve as differentiating criteria in individual cases. The difference of the means, excepting in groups II, is, however, statistically reliable. The tendency formerly noted for the extent of the discrepancy between the experimental and control groups to vary directly with the severity of the defect may be noted in the tapping test.

3. Inter-relations Between Factors Studied

It is not clear, from the data previously given, whether or not the speech defective group with which we are dealing is homogeneous with respect to its performance and status on various tests and measures applied. Specifically, our data give only inconclusive evidence as to whether the typical defective case is deficient in all factors studied, or whether different subjects within the general group are inferior in different factors.

Information is therefore needed on the relation of the status of the subjects on any given measure to their standing on other measures. The multiple correlation technique was used in the statistical analysis of the data from the defective subjects in groups I on the following factors: (1) age, (2) intelligence, (3) auditory acuity, (4) phonetic discrimination, (5) tapping, (6) tracing, (7) tensiometer. The following zero-order correlations were found (subscript refers to factors, as numbered above):

r12	.00	r24	.24	r37	.12
r13	.07	r25	.18	r45	.45
r14	.01	r26	.41	r46	.58
r15	.67	r27	.03	r47	.29
r16	.50	r34	.60	r56	.65
r17	—.11	r35	.35	r57	—.18
r23	.19	r36	.43	r67	—.10

The multiple correlation coefficient of the combined seven variables—ages, intelligence, auditory acuity, phonetic discrimination, tapping, tracing, tensiometer—is .50 p.e. ± .02. It must be noted, before discussion of this result is undertaken, that this correlation coefficient is probably misleadingly high, since a comparatively small number of cases (40) was examined.

With this reservation, we may infer that there is a slight positive relationship between the status of the subjects on the various measures. This may be interpreted to mean that there is a tendency for the speech defective child, in our cases, to be low in all factors studied, since the defective group was inferior as a whole to the normal group. The speech defective case thus presents a picture of general inferiority. However, the multiple R is low enough to necessitate also the conclusion that considerable variability is to be expected; that by no means all the experimental subjects were low in all measures. From a practical point of view we may infer that all of the factors studied might be associated with sound substitution defects, but any given case may display deficiencies on any one or more of the measures.

Some of the zero-order correlations are of interest. Age does not seem to influence auditory acuity or phonetic discrimination. Intelligence, as will be seen from the inter-correlations, does not correlate highly with any of the other measures. The largest coefficient of correlation is between intelligence and tapping (r_{26}—.41). Auditory acuity bears a significant relationship to phonetic discrimination, as would be expected, which is expressed in a correlation coefficient of .60 (r_{34}). The relation between tapping and tracing is expressed by a positive correlation of .65, which is not materially reduced when other factors are eliminated. Tensiometer performance apparently is unrelated to other factors studied.

Summary and Conclusions

It seems possible, on the basis of our research, to draw certain conclusions that may be of assistance in the management of sound substitution cases or that may at least suggest interesting hypotheses for future research. In many cases the data given serve only to verify statistically assumptions which have previously been made on the basis of incomplete evidence; in other instances, the data given do not support generally accepted conclusions.

The picture presented by these speech defective children studied

in the course of this investigation is one of general retardation. This is also true of speech, since it is clear from many studies that acquisition of the necessary finer motor co-ordinations depends upon chronological age. Our previous study found this retardation to hold true of intelligence, school achievement, physical status as measured by the anthropometric examinations, and auditory acuity. The findings included in this report show that sound substitution cases compare unfavorably with speech normal children in phonetic discrimination and motor ability. In some cases the discrepancies between the experimental and control groups were not great, yet all followed a common general tendency.

The knowledge that the speech defective child is generally retarded, which is here only statistically verified, is of no particular significance so far as clinical procedure in individual cases is concerned. The multiple correlation between the factors studied (.50, p.e. $\pm$ .02) emphasizes this. Such a correlation coefficient may be taken to indicate that many of the speech defective children were deficient in all the factors studied, but that there must be sound substitution cases who are normal in certain of the factors. Our study has not shown any single general factor invariably associated with sound substitution defects, but rather a varying functional relationship between specific factors.

From a practical point of view, our findings indicate that a careful series of diagnostic tests touching on the factors we have mentioned should be employed as standard clinical practice in dealing with sound substitution cases. It is true that corrective techniques now in use are reasonably effective, but it would seem probable that the most efficient re-educational measures would, in any given case, depend upon the nature and extent of the specific deficiencies which are shown to exist after such diagnostic testing.

The clinical examination probably should include the following factors:

1. PHYSICAL STATUS. A general physical examination would not seem superfluous in a general clinical study. Anthropometric examinations of the type given in our research would undoubtedly prove to be of assistance in understanding the "physical efficiency" of the subject not revealed by a general medical examination. The frequent abnormal discrepancy between the physical and psychophysical indexes found in the anthropometric examination of our subjects is cited in this connection. Our study agrees with that of

Wellman and others in suggesting the importance of general tests of motor co-ordination. General exercises adapted for motor development probably would be suggested in certain cases.

2. DENTAL EXAMINATION. While our study shows that there is little if any relation between sound substitutions and dental irregularities when the data are considered statistically, it is unquestionably true that occasional cases of sound substitutions may be attributed to this cause. If such a possibility exists in any given case the subject should of course have proper medical or dental attention.

3. HEARING EXAMINATION. We come here to a highly important phase of the clinical examination. Poor auditory acuity should always be suspected in the case of a sound substitution defect, and the necessity of a careful hearing examination cannot be emphasized too strongly. Reliance should be placed only upon some type of audiometric examination, and in doubtful cases careful re-tests should be undertaken.

Having determined the auditory acuity of the subject, with a careful charting of "tonal gaps" wherever possible, the examiner should then determine the discrimination ability of the subject. Our study and that of Travis and Rasmus indicate that very frequently individuals having sound substitution defects fail to discriminate between the correct and incorrect sounds. This condition would logically be anticipated in individuals whose hearing level is low, but it is of great clinical significance that many speech defectives are low in discrimination ability where auditory acuity is normal. Discrimination may be tested either by the oral method of Travis or from phonograph plates.[10]

Where auditory acuity and discrimination ability are poor, the same general techniques employed in instruction of the deaf may be effectively modified for an efficient clinical program.

It is recognized that the suggestions outlined are general in nature, and that the research possibilities in the field of sound substitution defects is scarcely touched. The evidence submitted seems clear enough, however, to indicate that refinement of our present technique of managing sound substitution cases would be entirely possible and profitable.

[10] The plates used in our examinations may be obtained from C. H. Stoelting Company, Chicago, Illinois.

TABLE I

COMPARISON ON PHONETIC DISCRIMINATION TEST

GROUP	N	MEAN NO. ERRORS	STANDARD DEVIATION	DIFFERENCE OF MEANS	STANDARD ERROR OF DIFF.	CRITICAL RATIO
E I	41	11.18	6.0			
C I	41	7.6	3.4	3.5	1.2	2.8
E II	20	7.0	1.8			
C II	20	6.7	2.1	.3	.6	.5
EXP	61	9.5	5.1			
CON	61	7.1	3.0	2.4	.7	3.8

TABLE II

FREQUENCY WITH WHICH SOUNDS WERE MIS-HEARD
(Experimental and Control Groups 1)
More severe defects

SOUND	EXPERIMENTAL		CONTROL		DIFFERENCE OF %
	RANK	%	RANK	%	
v	1	34.9	1	21.9	13.0
th	2	32.1	4	20.6	11.5
b	3	31.0	2	21.9	9.1
f	4	26.6	3	21.6	5.0
th	5	22.4	5	20.6	1.8
z	6	17.8	7	10.9	6.9
t	7	16.0	6	14.9	1.1
sh	8	12.6	3	6.5	6.1
m	9	10.9	14	3.4	7.5
zh	10	10.3	10	5.6	4.7
d	11	9.4	23	0.8	8.6
g	12	8.6	21	1.1	7.5
p	13	8.2	11	4.8	3.4
r	14	7.5	25	0.6	6.9
w	15	7.5	25	0.6	6.9
e	16	6.4	12	4.4	2.0
l	17	5.9	17	2.4	3.5
k	18	5.1	15	3.4	1.7
n	19	5.1	24	0.8	4.3
ʌ	20	4.5	18	2.2	2.3
):	21	3.9	22	0.9	3.0
u:	22	3.9	27	0.4	3.5
ae	23	3.4	13	4.0	–0.6
i:	24	3.4	28	0.0	3.4
i	25	3.4	16	3.4	0.0
m	26	3.4	19	1.7	1.7
a:	27	2.8	9	5.7	–2.9
j	28	1.7	20	1.7	0.0
u	29	0.0	29	0.0	0.0
ng	30	0.0	30	0.0	0.0

TABLE III

FREQUENCY WITH WHICH SOUNDS ARE MIS-HEARD
(Entire Groups)

SOUND	EXPERIMENTAL		CONTROL		DIFFERENCE OF %
	RANK	%	RANK	%	
f	1	25.0	1	23.0	2.0
b	2	23.0	3	19.0	4.0
th	3	22.0	2	20.0	2.0
v	4	21.0	5	16.0	5.0
th	5	17.0	4	17.0	0.0
sh	6	9.0	8	8.0	1.0
l	7	8.0	9	5.0	3.0
z	8	7.0	66	9.0	–2.0
zh	9	6.0	10	5.0	1.0
a:	10	6.0	18	2.0	4.0
d	11	5.0	20	1.0	4.0
g	12	5.0	21	1.0	4.0
e	13	5.0	12	5.0	0.0
p	14	4.0	14	3.0	1.0
w	15	4.0	24	0.6	3.4
t	16	3.0	15	3.0	0.0
k	17	3.0	16	3.0	0.0
r	18	3.0	22	1.0	2.0
i	19	3.0	19	2.0	1.0
æ	20	3.0	11	5.0	–2.0
ʌ	21	3.0	26	0.5	2.5
s	22	2.0	13	4.0	–2.0
n	23	2.0	17	3.0	–1.0
):	24	2.0	23	1.0	1.0
u:	25	2.0	27	0.5	1.5
m	26	1.0	25	0.6	0.4
j	27	0.8	7	9.0	–8.2
i:	28	0.7	28	0.5	–0.2
u	29	0.0	29	0.0	0.0
ng	30	0.0	30	0.0	0.0

TABLE IV

FREQUENCY WITH WHICH SOUNDS AVOIDED ARE MIS-HEARD IN PHONETIC DISCRIMINATION TEST
(All sounds avoided more than 5 times)

SOUND	EXP. I	CON. I	DIFF. OF %	EXP. GROUP	CON. GROUP	DIFF. OF %
z	17.8	10.9	6.9	7.0	9.0	–2.0
s	2.8	5.7	–2.9	2.0	4.0	–2.0
th	22.4	20.6	1.8	17.0	17.0	0.0
th	32.1	20.6	11.5	22.0	20.0	2.0
r	7.5	0.6	6.9	3.0	1.0	2.0
k	5.1	3.4	1.7	3.0	3.0	0.0
g	8.6	1.1	7.5	5.0	1.0	4.0
sh	12.6	6.5	6.1	9.0	8.0	1.0
v	34.9	21.9	13.0	21.0	16.0	5.0
l	5.9	2.4	3.5	3.0	2.0	1.0
d	9.4	0.8	8.6	5.0	1.0	4.0
t	16.0	14.9	1.1	3.0	3.0	0.0

TABLE V

FREQUENCY WITH WHICH SOUNDS PREFERRED IN SUBSTITUTIONS ARE MIS-HEARD IN PHONETIC DISCRIMINATION TEST
(All sounds preferred more than 5 times)

SOUND	EXP. I	CON. I	DIFF. OF %	EXP. GROUP	CON. GROUP	DIFF. OF %
d	9.4	0.8	8.6	5.0	1.0	4.0
w	7.5	0.6	6.9	4.0	0.6	3.4
f	25.6	21.6	4.0	25.0	23.0	2.0
t	16.0	14.9	1.1	3.0	3.0	0.0
l	5.9	2.4	3.5	3.0	2.0	1.0
v	34.9	21.9	13.0	21.0	16.0	5.0
th	32.1	20.6	11.5	22.0	20.0	2.0
th	22.4	20.6	1.8	17.0	17.0	0.0
b	31.0	21.9	9.1	23.0	19.0	4.0

TABLE VI

COMPARISON OF TIMES PAIRED SOUNDS INVOLVED IN SUBSTITUTIONS WERE MIS-HEARD IN PHONETIC DISCRIMINATION TESTS

DEFECT	TIMES USED BY SUBJECTS	PERCENT OF CASES MISSING COMPARISON						
		EXP. I	CON. I	DIFF.	EXP.	CON.	DIFF.	AV.
f-th	38	93.1	87.2	5.9	84.0	82.9	1.1	83.8
w-r	33	24.1	0.0	24.1	3.8	0.0	3.8	1.9
v-*th*	25	86.2	58.6	27.6	76.9	57.4	19.5	67.7
t-k	22	6.8	13.7	–6.9	5.7	8.5	–2.8	7.0
d-g	19	6.8	0.0	6.8	3.8	2.1	1.7	2.9
l-s	14	6.8	0.0	6.8	3.6	0.0	3.6	1.9
d-*th*	13	(no comparison)						
th-z	13	68.9	62.0	6.9	55.7	68.0	–12.3	61.6
th-s	13	11.2	27.2	–16.3	9.6	19.1	–9.5	14.1
b-v	7	75.8	55.1	20.7	71.1	63.6	7.5	67.7
w-l	6	6.8	0.0	6.8	5.8	0.0	5.8	1.9

TABLE VII

COMPARISONS ON TENSIOMETER EXAMINATION

GROUP	N	AV.	STANDARD DEVIATION	DIFF. OF MEANS	STANDARD ERROR OF DIFFERENCE	CRITICAL RATIO
			RIGHT HAND			
E I	41	14.1	7.4			
C I	41	10.2	3.0	3.9	1.3	3.0
E II	20	14.8	3.6			
C II	20	11.9	4.3	2.9	1.3	2.2
Exp.	61	14.2	7.2			
Con.	61	10.9	4.4	3.3	1.3	2.5
			LEFT HAND			
E I	41	14.4	5.6			
C I	41	10.7	5.6	3.7	1.3	2.8
E II	20	12.4	4.0			
C II	20	11.4	7.2	1.0	1.4	.71
Exp.	61	13.5	6.2			
Con.	61	12.4	5.6	1.1	.82	1.3
			AVERAGE OF BOTH HANDS			
E I	41	14.2	7.2			
C I	41	10.5	4.4	3.7	1.4	2.6
E II	20	12.8	3.4			
C II	20	12.0	4.0	.8	.89	.89
Exp.	61	14.8	5.2			
Con.	61	10.4	4.2	4.4	.94	4.6

TABLE VIII

COMPARISONS ON TRACING TEST

GROUP	N	AV.	STANDARD DEVIATION	DIFF. OF MEANS	STANDARD ERROR OF DIFFERENCE	CRITICAL RATIO
E I	41	7.3	4.7			
C I	41	9.4	2.9	2.06	.67	3.07
E II	20	9.6	3.8			
C II	20	7.8	3.8	−1.78	.89	2.0
Exp.	61	8.08	4.4			
Con.	61	8.84	4.6	.62	.78	.79

TABLE IX

COMPARISONS ON TAPPING TEST

GROUP	N	AV.	STANDARD DEVIATION	DIFF. OF MEANS	STANDARD ERROR OF DIFFERENCE	CRITICAL RATIO
			RIGHT HAND			
E I	41	137.0	14.7			
C I	41	144.0	13.7	7.0	2.3	3.0
E II	20	150.0	9.7			
C II	20	150.0	14.5	0.0	0.0	0.0
Exp.	61	143.0	17.4			
Con.	61	149.0	16.1	6.0	2.2	2.7
			LEFT HAND			
E I	41	134.0	14.1			
C I	41	143.0	13.9	9.0	1.9	4.7
E II	20	146.0	10.1			
C II	20	147.0	14.6	1.0	2.9	0.34
Exp.	61	140.0	17.1			
Con.	61	145.0	16.7	5.0	1.7	2.9
			AVERAGE OF BOTH HANDS			
E I	41	135.5	14.5			
C I	41	143.5	13.5	8.0	2.5	3.2
E II	20	141.5	17.0			
C II	20	147.0	16.9	6.5	2.4	2.7

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TONGUE MOVEMENTS AND VOWEL QUALITY

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TONGUE and lip movements which occur in the normal articulation of the different vowel sounds are responsible for variations in the resonant characteristics of the channel leading from the larynx to the outer air. This may easily be demonstrated. Suppose a vibrating tuning fork be held just in front of the opened mouth. If the oral cavity is properly tuned by the tongue and lips the sound produced by the tuning fork will be noticeably amplified by resonance. The maximum resonant effect is somewhat difficult to maintain because the slightest change of tongue or lip position alters the mouth's resonant characteristics. Similarly it may be shown that the resonant characteristics of the vocal channel differ from vowel to vowel. These characteristics seem to be responsible for the so-called *vowel resonances* in whispered speech.

The movements of the articulatory organs during phonation are similar to those occurring during whispered speech. One would expect, therefore, to find a resonant amplification of those harmonics within the complex glottal tone whose frequencies lie close to the resonant frequencies of the vocal channel for any particular vowel configuration. Various studies involving harmonic analyses indicate that such resonant effects do occur.

Yet, we are not justified in assuming that the movements of the various articulatory organs during the process of phonation are concerned solely in adjusting the resonant characteristics of the vocal channel, nor that these resonant characteristics are the only factors of importance in determining vowel quality. X-ray studies[1] reveal that different speakers differ radically in the vocal channel configurations employed in the production of the same vowel. Furthermore, they have shown that a person may produce the same vowel with radically different tongue positions at different times due to the influence of neighboring sounds in connected discourse. The extent to which observed changes of the vocal channel resonant characteristics are nec-

[1] Russell, G. Oscar, *The Vowel*, Ohio State University Press, 1928.
————, *Speech and Voice*, New York: Macmillan Company, 1931.
————, "The Mechanism of Speech," *J. Acous. Soc. America*, 1, 1929, 83–109.

essary in vowel production and the extent to which they may be unimportant in this regard has been given little attention. There is the possibility, for example, that an observed rise of the tongue in the mouth may be a by-product of some more important adjustment elsewhere. This may be an enlargement of the pharyngeal cavity immediately above the larynx or some adjustment of the extrinsic laryngeal musculature which in turn is concerned in a variation of the laryngeal tone quality.

Yet, phoneticians generally have assumed without proof that every movement of the tongue will be accompanied by a definite change in vowel quality as a result of altered oral cavity resonance. We frequently see minor deviations of vowel quality described in terms of a slight lowering or raising of the tongue with respect to the "normal" position for a given vowel.

We cannot control the organs of articulation independently nor determine from sensations just what is occurring within our vocal apparatus. For example, until the x-ray revealed the fact we did not know that the transition from the vowel [ɑ] to the vowel [i] is accompanied by a radical enlargement of the pharyngeal cavity. We had previously seen only the rise of the tongue within the mouth. Hence, if we wish to study the effect of varying the oral cavity volume alone we must seek an independent method whereby this can be done. For this purpose we have developed a new false-palate technic.

The [i]-Cavity Palate

This technic for independently varying the oral cavity dimensions occurred to the writer while conducting some palatographic experiments with false palates made of dental base-plate wax.[2] A sheet of this wax is warmed and pressed carefully against the palate, alveolar ridge, and teeth until it follows every surface feature of these parts. The hardened palate is then dusted with starch or powdered sugar on its under surface, replaced in the mouth, and any desired sound articulated. When the palate is carefully removed the areas of tongue-palate contact are found to be clearly indicated by the removal of the dusted powder over these areas.

Since the vowel [i] normally involves the highest tongue position

[2] The construction and use of these [i]-cavity palates was first described in the author's dissertation, presented in partial fulfillment of the requirements for the degree of Doctor of Philosophy: Cotton, Jack C., *A Study of Certain Phoniatric Resonance Phenomena*, Ohio State University, 1936, pp. 37–51.

of all the vowels its palatogram indicates a considerable area of tongue contact with the palate, teeth, and teeth ridge. This is represented by the shaded portion of the palatogram in Figure 1. The unshaded portion of this figure represents the upper surface of the oral channel involved in the production of this vowel. The lower surface was supplied, of course, by the tongue.

If an artificial lower surface for this [i]-cavity be built onto the false palate it is no longer necessary for the tongue to rise in order to produce the oral cavity characteristic of the vowel [i]. Instead, the false palate provided with such a bottom can be placed in the mouth, any desired vowel sustained, and the space between the tongue and the false palate bottom closed by a water-filled rubber balloon. In this way the oral cavity configuration can be converted into that characteristic of the vowel [i] without any movement of the tongue or other articulatory organs. One can then directly observe the effect of this change on the resonant characteristics of the oral cavity.

In constructing these [i]-cavity palates a thick paste of glue and salt was used to fill the space on the original palates which had not been touched by the tongue in the articulation of the vowel [i]. The thickness of this filling was tapered to zero at the line of tongue contact with the palate and given a median line thickness determined by means of wax "feelers" stuck onto the underside of the original false palate. After this paste filling hardened a piece of softened wax was shaped over the filling and sealed to the underside of the false palate with a heated tool. The glue salt cement was then dissolved out, leaving the completed [i]-cavity palate ready for use.

Experimental Results

With the [i]-cavity palate in the mouth it was possible to articulate the vowel [i] quite normally. In this case the tongue came up into contact with the lower surface of the false bottom. An oscillogram of this vowel is shown in Figure 3.[3]

Leaving the false palate in the mouth, a small rubber balloon connected by a tube with a suspended rubber bag of water was placed on top of the tongue. This balloon could be filled with water at will by elevating the large rubber bag. While sustaining various vowels

[3] Figures 3 to 10 are accurate tracings from oscillograms obtained with a General Radio cathode ray oscillograph, type 687-Bm, using a sweep circuit. The frequency characteristics of the system were substantially flat over the range from 100 to 7,000 cycles per second.

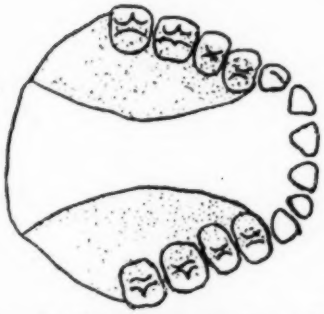

Fig.1.Palatogram of the vowel (i) as voiced by the writer on f (175 cps). This pitch used thruout.

Fig.2.Side view of the same palate. The dotted line is the tongue contact line seen from the side.

Fig.3. Vowel (i).

Fig.4. Vowel (∧).

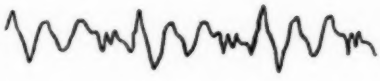

Fig.5.(∧),(i)-cavity.

Fig.6. Vowel (U).

Fig.7.(U),(i)-cavity.

Fig.8. Vowel (u).

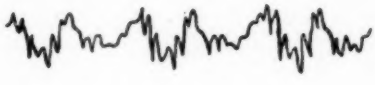

Fig.9.(u),(i)-cavity.

Fig.10."Bright"(u).

in turn, water was allowed to fill the balloon in the mouth. The water-filled balloon effectively closed the space between the tongue and false palate, thus changing the oral cavity dimensions to those characteristic of the vowel [i] without the necessity for any movement of the tongue.

Under these conditions one might expect a rather marked change to occur in the quality of any vowel (other than [i]) being voiced. Indeed, if the various vowel triangle theories were sound, all vowels should become [i] under these conditions, since these theories disregard everything except the position of the tongue in the oral cavity.

Figure 4 is an oscillogram of the vowel [ʌ] made with the [i]-cavity palate in the mouth, but without any water-filled balloon between the tongue and false palate. This [ʌ] was not perceptibly different from that secured without the palate in the mouth. In Figure 5 is an oscillogram secured while voicing this same vowel, but with the water balloon completely filling the space between the tongue and false palate.

As one may readily see by comparing these oscillograms there was practically no change of vowel quality resulting from this very radical change in the oral cavity volume. Obviously the quality did not become that characteristic of [i]; if this had occurred the oscillogram in Figure 5 would have resembled that in Figure 3. Listeners could detect no quality variation; there was simply a slight decrease in loudness.

It was found that any vowel sound can be produced without loss of its characteristic quality in spite of these abnormal oral cavity conditions. The vowel [ɑ] like the vowel [ʌ] was practically unchanged in quality. As may be seen from Figures 6 and 7, the vowel [ʊ] was affected somewhat more.

The maximum change resulting from the artificially modified oral cavity was obtained for the vowel [u]. Oscillograms for this vowel are shown in Figures 8 and 9. In spite of this rather marked change of wave-shape, however, the vowel remained an unmistakable [u] though possessing a "bright" quality. This quality is frequently heard both in song and speech. Figure 10 illustrates this point in an oscillogram of a "bright" sung vowel [u].

Conclusions

Radical changes in the oral cavity resonant characteristics (as a result of volume variations in that cavity) do not result in a loss of vowel character, no matter what vowel is being voiced. Since these

variations in the oral cavity volume would necessarily cause an alteration in the resonant characteristics of the pharyngeal cavity also it appears that more than resonance must be concerned in vowel differentiation. It seems likely that the quality of the original laryngeal tone is varied in the voicing of different vowels.[4]

The observation that the vowel [u] is most affected by an artificial reduction in the oral cavity volume probably results from the fact that these two vowels, [u] and [i], are alike in being produced with a distended pharyngeal cavity. Hence, the artificially altered cavity configuration for [u] is more nearly identical with the normal configuration for [i] than is the case for any other vowel.

These results confirm the conclusions previously drawn from x-ray studies that we are not justified in classifying vowels according to tongue position such as is attempted in various "vowel triangle" schemes.

[4] Russell (*Speech and Voice*) presents laryngoscopic evidence which strongly suggests this possibility. The writer's oscillograms of the laryngeal wall vibrations (see dissertation referred to above, pp. 60–67) further support this view.

VOCAL FOLD MOVEMENT DURING VOCALIZATION

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LARYNGOLOGISTS, voice scientists, phonologists and others interested in laryngeal problems are still speculating on how the vocal folds vibrate during the production of sound. A number of studies have been made, but their results have been confusing and frequently contradictory: first, because the vocal lips vibrate too fast for the unaided eye to follow; and second, because the apparatus used to aid the eye has had certain inherent limitations. Consequently, the development of new equipment which eliminated the weaknesses of the old has led to renewed investigation of this important topic.

The apparatus most commonly used in the study of rapidly rotating or oscillating bodies is the stroboscope. This instrument creates an optical illusion by which the observer may see fast-moving objects as though they were motionless, or moving slowly.

Another and newer method for studying rapid movement employs an ultra high speed motion picture camera. This apparatus includes some of the stroboscopic principles, but eliminates the "illusion factor" of the stroboscopic observations and presents photographs for objective study. The present report includes information gathered by both methods.

The primary requirement for the stroboscopic illusion is regularly interrupted viewing. The stroboscope, the apparatus which permits the intermittent viewing of the moving object, has a great many forms. Traditionally, it has been a large rotating disc with equally spaced radial slots near the periphery. Sometimes the disc has been placed between the observer's eye and the object to regularly interrupt the vision; at others, it has been set to cut the light beam, thereby allowing the object to be alternately illuminated and darkened. In either method, if the observer sees the moving object at the same frequency as its movement or at a multiple of its frequency, the stroboscopic illusion will be obtained.

Unfortunately for laryngeal research, there is an inherent weakness in the disc and other mechanical types of stroboscopes. Metzger was the first to describe this limitation and to point it out as a source of misinformation.[1] His contention was that the revolving, perforated

[1] Metzger, W., "The Mode of Vibration of the Vocal Cords," *Psych. Monog.*, 38, 1928, 124.

disc, whether interrupting the light beam or the investigator's vision, swept across the field exposing it increasingly to its maximum and then diminishing it to its extinction. If, during the sweep of a single perforation, the field be moving rapidly, as in the vibration of the vocal folds, one section of the field would be seen in one position and its neighbor in another; but since this occurs too fast for the eye to follow, the observer gets an illusion of a non-existing curve which is the resultant of the light movement and the field movement.

To overcome this difficulty, it would be necessary to use an instrument which would allow the observer to see the whole field simultaneously. This has been accomplished with the glow-lamp stroboscope, in which the light source flashes briefly at any desired frequency. This permits all parts of the object to be illuminated at once, thereby eliminating the major objection of the mechanical instruments. In addition, the extreme shortness of the flash permits the stroboscopic image to be sharper than with the best of the older stroboscopes.

A glow-lamp may take almost any size or shape so long as the passage between the electrodes is filled with an inert gas such as neon, argon, helium, etc. The many electric neon (orange) and argon (blue) signs in store windows, which could be used as stroboscopes, illustrate these facts well. The glow occurs when the gas is ionized by the passage of an electric current through it. A short current impulse produces a correspondingly short flash which will occur as often as the current passes.

Industry has used glow-lamp stroboscopes since about 1922, but they were not applied to laryngeal investigation until 1932.[2] Since then a few others have reported their work.[3,4,5,6,7,8]

[2] Clary, ————, "La Phonoscope à Cordes Vibrantes," *R. Sci.*, 70, 1932, 462–467.

[3] Pollak-Rudin, R., and Stein, Leopold, "Ein neues handliches Laryngostroboskop," *Wiener med. Wschr.*, 82, 1932, 916–917.

[4] Kallen, L. A., and Polin, H. S., "A Physiological Stroboscope," *Science*, 80, 1934, 592.

[5] ————, "Physiological Stroboscope," *Science*, 82, 1935, 377.

[6] ————, "A Laryngo-Stroboscope and Comment upon Dr. West's Reference to Same," *Q. J. Speech*, 23, 1937, 119–126.

[7] West, Robert, "A View of the Larynx Through a New Stroboscope," *Q. J. Speech*, 21, 1935, 355–361.

[8] Moore, George Paul, "A Stroboscopic Study of Vocal Fold Movement," *Summ. of Doctoral Dissertations*, Vol. 4, Northwestern University, Chicago and Evanston, 1936.

In the last reference just cited, the vocal lip movements of one person with a normal larynx were studied at several frequencies and intensities by means of a specially developed glow-lamp stroboscope. This apparatus consisted of a stimulator (either an oscillator, or a microphone for the voice), an amplifier, a timing circuit, and a specially designed glow-lamp. These parts, functioning as a unit, were capable of delivering a brilliant short flash, ideal for vocal fold study.

In the investigation just referred to, it was noted that as the pitch was raised the vocal folds lengthened and narrowed, and the amplitude of movement diminished. In the lowest frequency studied (160 d.v.), there were prominent wave-like progressions along the edges of the folds. In the next two higher steps (200 and 250 d.v.), the wave-like movement was present, but it became progressively less noticeable because of the decreased amplitude. In the three highest frequencies studied (300, 350 and 400 d.v.), the wave-movement seemed to be replaced by a simpler approaching and receding motion; and in the latter two, portions of the posterior segments of the folds were pressed tightly together, thereby reducing their vibrating lengths.

The wave-like opening and closing of the glottis was very prominent to all observers. That it was a condition peculiar to the individual larynx observed is only remotely possible since Clary,[9] who first used the glow-lamp strobolaryngeal technique, reported a similar movement, and Tiffin said he had observed the waving motion. In addition, the writer has since observed the same effect in a female larynx and in that of another male. Thus it is highly probable, at least in the lower range of the individual's voice, that the characteristic vocal lip vibrations are wave-like.

A wave is a progression. In a repeating wave form, the progression passes from one position through a series of changes and back to the original point. Stroboscopic observation readily showed that the vocal lips performed a complex repeating pattern, but the study of this wave form in its several phases was more difficult and the results somewhat less certain.

Wave analysis with the stroboscope was accomplished by synchronizing, as nearly as possible, the vibratory frequency of the vocal lips and the flash frequency of the glow-lamp. Exact synchronization, producing perfect stillness, was obtained for only very short periods, after which the pitch would slide slightly above or below the flash

[9] *Loc. cit.*

frequency, causing variations in the rate of apparent movement. Conclusions concerning the movements were obtained during the brief stationary periods and the slight drifting of pitch.

Repeated observations indicated that the wave movement probably originated somewhat anterior to the center of the glottis with a small opening which widened and lengthened posteriorly. It seemed then that when the separating segments neared the arytenoids, the anterior parts began the closure which also traveled posteriorly, leaving the glottis closed in its wake. A slight variation seemed to be present occasionally. When the closure was almost completed, a second wave originated as its predecessor had so that in one brief phase of the cycle there were two small openings separated by a closed portion.

The possibility of error in these observations brought a desire to photograph the vocal-lip activity. Since the illumination used in the stroboscopic study was not sufficient for photographing, Prof. H. E. Edgerton, of the Massachusetts Institute of Technology, was approached for the possibility of using the special high speed camera which he and others at the Institute had developed. He readily assented, making it possible to continue the research as described in the following sections of this paper. Prof. Edgerton's apparatus represents the greatest development in high speed motion picture photography yet achieved; it is capable of making more than 4,000 exposures a second.

The camera and light source, which always must be considered together, differ considerably from an ordinary motion picture camera and its illumination. The high speed camera proper has the customary supply and take-up spools, but attached to the shaft of the latter is an electric motor which winds the film. At the lens a large sprocket is mounted, over which the film travels continuously. There is no shutter or intermittent movement mechanism. On an extension of the sprocket shaft there is a contactor wheel with contact points three-fourths of an inch apart around the periphery. The distance between the points equals the running dimension of a frame on a 35 mm. motion picture film. That is, each time the film moves forward the distance of one frame, another contact point moves into position to close a circuit. This circuit controls the light source as explained later.

The lamp, mentioned previously as an integral part of the photographing apparatus, is a gas-filled glow-tube similar to the one referred to in the foregoing brief description of the stroboscopic appa-

ratus. Its particular features are its great intensity and shortness of flash, both made possible by the electric supply circuit. The period of flash is less than one-millionth of a second, and the intensity is controlled by the amount of current flowing through the tube on each impulse. The exposure of a section of film in less than one-millionth of a second gives some indication of the light intensity.

When the camera and glow-lamp are set up for photographing, they are attached to each other through the contactor wheel on the camera. This wheel is in a thyratron control circuit in such manner that when the contactor points close the circuit, the thyratron resistance breaks down, allowing a heavy current to pass to the glow-lamp, causing it to flash. This occurs each time the film moves forward one frame. The flash is so short and so intense that clear pictures are obtained on the constantly moving film even at the highest exposure rates.

To take the laryngeal pictures, the apparatus was used as just described, but its several parts had special arrangement with reference to the subject photographed. The glow-lamp was mounted in the center hole of an automobile headlamp reflector, and the reflector was placed to direct the light horizontally into the seated subject's mouth. Just at the side of the lamp socket a one-inch hole was cut in the reflector, through which the camera lens was aimed at the guttural mirror in the subject's pharynx. This arrangement permitted the lens and light axes to be almost superimposed, a necessity in laryngeal photography where a single guttural mirror is used.

At the edge of the reflector hole for the lens, a small mirror was mounted permitting the subject to see his vocal lips reflected in the guttural mirror and thereby to direct the desired image to the camera. Some such arrangement for auto-examination is necessary when the subject is manipulating the guttural mirror.

The technique for taking the pictures was comparatively simple after the apparatus was arranged and the proper focus established. The subject slipped the guttural mirror into the pharynx, reflected the image of the vocal lips in the small mirror beside the lens, and gave the camera operator a signal to start the camera. The subject had only to hold his position and to make the sounds whose production he wished to photograph.

It was mentioned previously that the camera was capable of making over 4,000 exposures a second. That rate was not possible, however, in this laryngeal photography because a great deal of light

was lost by the smallness of the guttural mirror; i.e., all the light was not concentrated on it, and as a consequence only a portion of the light reached the larynx. The highest rate attained successfully was slightly over 1200 exposures a second; sufficient, it may be seen from the accompanying photographs, for a frame-by-frame study, but not for projection, for at the vocal fold frequency photographed only five to six exposures were made in each cycle. This was not fast enough to give a smooth projected picture.

The pictures taken present interesting facts which seem to confirm some of the stroboscopic results and to refute others.

Figure I shows a series of enlargements of consecutive frames of a 35 mm. film taken at 1200 exposures a second. The subject's pitch at the moment of photographing was approximately 220 d.v. Figure II is another series taken at 720 exposures a second at a pitch of approximately 190 d.v. Figure III is from a stroboscopic film which will be discussed separately after the first two.

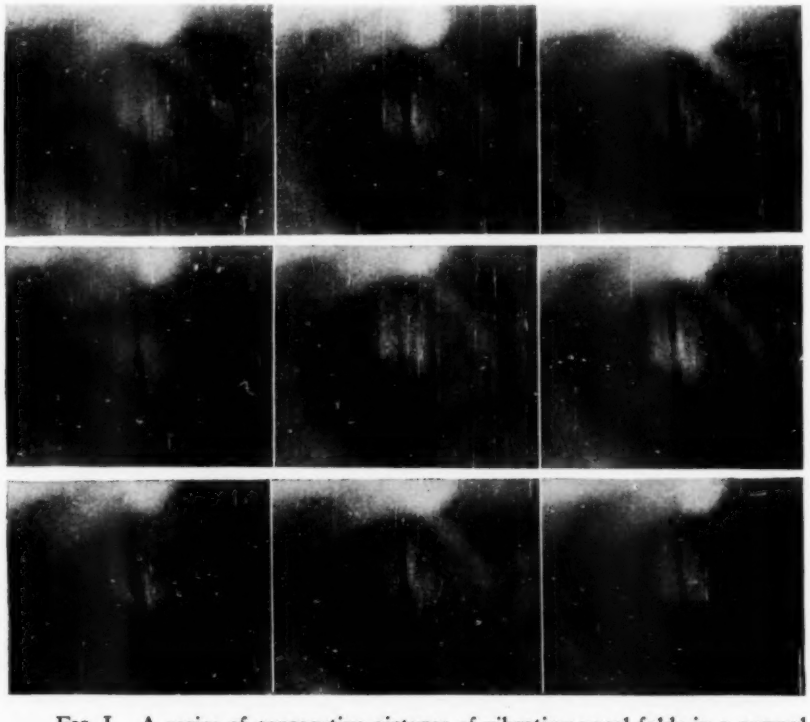

FIG. I. A series of consecutive pictures of vibrating vocal folds in a normal adult, male, human larynx. Exposure rate: 1200 a second; pitch of the tone produced: approximately 220 d.v. Pictures number from left to right.

The extraneous parts of the pictures have been trimmed away to conserve space, leaving scarcely more than the image of the larynx as reflected in the guttural mirror. This reduction makes it difficult to orient the image; therefore, the structures will be pointed out before an analysis of the pictures is attempted.

Each photograph presents the laryngeal image as reflected in a guttural mirror held in the pharynx. The anterior structures are shown toward the top of the pictures; the left parts lie to the reader's right. The two light, band-like structures in the central position are the vocal folds, and the dark space between them is the glottis. The shaded portions bordering the vocal folds laterally are the ventricular folds, or false cords. The two dark masses in the lower part of the pictures are the arytenoids and associated structures. The apparent dissimilarity between them is due more to the angle at which the folds were viewed than to the slight swelling on the one to the left. The light, curved line extending from the anterior portion of the vocal folds (top of picture) downward and to the right is the upper border of the epiglottis. The other side of it was not reflected in the mirror; therefore, the downward curve to the left is the rim of the mirror.

The varying brightness of the pictures was caused by different light intensities. Figure I, as a whole, is darker than Figure II because the flash frequency was greater in the former, giving the condensers less time to build up their charge, thereby resulting in a diminished current and a dimmer light. Variation in condenser discharge also accounts for the different densities among the individual pictures of the first two figures.

A frame by frame study of the high speed films, both 1200 and 720 exposures a second, indicated that the glottis opened progressively, as observed stroboscopically. The opening began somewhat anterior to the center of the vocal folds and progressed posteriorly. This may be seen in Figure I, numbers 1 and 2; also 5, 6 and 7; and in Figure II, numbers 2 and 3. Figure II does not show this characteristic as well as does Figure I because fewer pictures per cycle were taken in the Figure II film.

In the stroboscopic study, the closing phase was reported as beginning anteriorly and moving posteriorly about as in the opening progression. These pictures do not show this. It appears from them rather that the closing occurs in the opposite direction from the opening. That is, the posterior section of the glottis is the last to open

FIG. II. A series similar to that in Fig. I, except the exposure rate was 720 frames a second and the pitch about 190 d.v. Pictures number from left to right.

and the first to close. This may be seen in Figure I, numbers 3, 4 and 5; also 7, 8 and 9; and in Figure II, numbers 3, 4 and 5; 6 and 7; and 11, 12 and 13. It will be noticed that pictures 2 and 3 of Figure I are quite similar. No. 2 apparently shows a position just before the maximum opening and No. 3 just following it, a good example of the similar though opposite opening and closing progressions.

These two pictures also give some indication of the fold shapes which result in the wave appearance when viewed stroboscopically. Note the sharp curve the folds make as they swing away from their contacting portions. If this shape progressed along the folds in a stroboscopic observation, it would give a waving appearance. At lower frequencies, when the amplitude of movement is greater, the curve of the folds is more marked and, consequently, also the waving movement. It is a common observation that the amplitude of movement lessens as the pitch rises, and the edges of the vocal folds concurrently become straighter.

It is clear from these high speed pictures that the vocal folds perform a complex opening and closing wave-like movement. It is also evident that the opening phase of this vibration begins slightly anterior to the center of the folds and progresses posteriorly. These two points substantiate the stroboscopic observations. On the other hand, the pictures show the closing phase to begin at the posterior attachments and to progress anteriorly. This contradicts the stroboscopic report, and is probably more accurate.

The pictures in Figure III are stroboscopic, and because of their fundamental difference from those in the other illustrations they have been reserved for special discussion. This figure is made up of enlargements of consecutive frames from a 35 mm. motion picture film taken with a normal speed camera while using the flashing light, employed in the high speed films, as illumination. The set-up was essentially the same as that described for the high-speed pictures, except a standard camera was substituted for the high-speed camera, and the glow-lamp was controlled by a motor driven contactor instead of the wheel on the first camera. This apparatus was, in reality, a glow-lamp stroboscope with a standard speed camera substituted for the customary observer.

To take the pictures, the movement of the subject's vocal folds and the light flashes were synchronized, the light being timed at a sub-multiple of the vibration frequency. The subject held the synchronization as closely as possible by watching the folds in the small

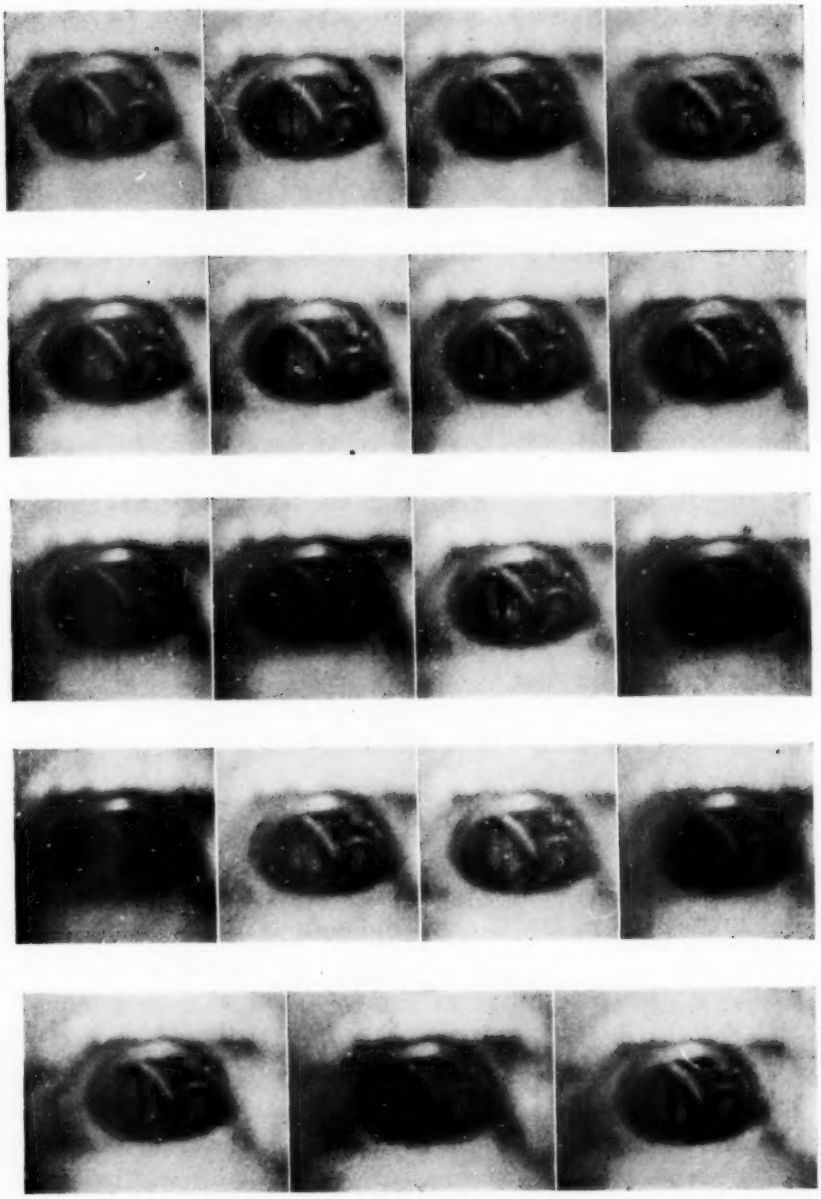

FIG. III. A series of consecutive pictures from a stroboscopic film. Pictures number from left to right.

mirror beside the lens, as described in the account of the high-speed photography.

The film from which these pictures were taken projects very well, showing the wave-like movements of the vocal folds as seen stroboscopically. It is for this pictorial and illustrative reason that this section has been presented, rather than for its value in a frame by frame analysis. The individual pictures show clearly the type of movement which has been described earlier, but there are certain reservations which must be laid on any conclusions resulting from an analysis of stroboscopic film.

In the first place, it is humanly impossible to prevent uneven pitch variations. These irregularities produce consecutive stroboscopic pictures which do not represent the movements accurately in relation to time. That is, if the pitch is sliding downward, the wave motion along the folds appears to travel in one direction, and the illusion is reversed when the pitch goes up. Moreover, the rate of apparent movement varies directly wtih the closeness of synchronization. These variations show as inconstant amounts of movement from frame to frame, which might lead to erroneous conclusions concerning the amount and type of movement in any period of time. For example, how is one to know from these pictures alone that the pitch shown in pictures 1, 2, 3, 4 and 5 of Figure III continues through pictures 6, 7, 8, 9 and 10? A slight upward slide might have changed at picture 5 into a gradual downward slide. These difficulties may be eliminated, however, by recording the pitch variations so they may be reproduced as sound with the pictures.

A second condition making accurate conclusions difficult in a frame by frame study of stroboscopic film is that the lamp flashes several times during the exposure of each frame, making, in reality, several superimposed pictures on each section of the film. Where synchronization between lamp flash frequency and the movement of the vocal folds is perfect, the double or triple exposures make no difference; but where there is a slight pitch change, each flash exposes the folds in a slightly different position and is thus apt to produce a somewhat blurred vocal fold image.

A third possibility for error is where a single flash is not quite strong enough to make a picture and the light flashes several times during the exposure of each film frame. In this case, although each flash alone is not brilliant enough to form the picture, the combination of successive flashes will be, with the resulting image a com-

posite of the overlapping positions of the folds. This composite might produce a picture of a fold position not actually existing.

It is impossible to say what effect this condition has had on the pictures in Figure III. A comparison of them with those in Figures I and II shows no large differences. However, there is evidence on most of the film frames (shadows of the camera shutter) that two or more flashes occurred for each exposure. Picture 13 of Figure III probably had only one flash.

These limitations have been pointed out to explain why stroboscopic film in general is not subject to a frame by frame study of the vibratory movement of the vocal folds, and, also, by indirection, to indicate the additional value of ultra high-speed photography.

This research has included too few subjects for unreserved acceptance of the results. However, it may be concluded with reasonable certainty from the information thus far collected that the vocal folds vibrate in a complex manner which has the characteristics of wave motion (at least within the medium and lower ranges of the voice). It may also be said that this wave motion begins with the folds separating at the anterior portions, and that the opening advances posteriorly to the arytenoids. This is immediately followed by the reverse action, in which the folds come together posteriorly and the closure travels anteriorly until the folds are in complete contact. After this a new wave starts. In this vibration the anterior portions of the folds are in contact for a shorter period during each cycle than are the posterior parts.

The studies reported here are being continued for further information on the nature of vocal fold vibration and for other facts of laryngeal functioning.

AN OBJECTIVE STUDY OF EMPHASIS IN ORAL READING OF EMOTIONAL AND UNEMOTIONAL MATERIAL*

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I. The Problem

THE question as to what constitutes emphasis[1] in oral reading has been given much thought and attention by phoneticians and others interested in the field of speech. All seem to agree that emphasis is dependent upon the four properties of the voice: pitch, intensity, duration and quality, but concerning the relative importance of these factors varying and contradictory opinions have been offered. It has been stated[2] that the chief means of emphasizing a syllable is by increasing its force or loudness. Conversely, it has been contended[3] that loudness is the most primitive, the least important and least subtle way of obtaining emphasis. Those holding this view usually feel that pitch is the important factor in emphasizing words.

The purpose of this study is to determine the extent to which emphasis in oral reading of emotional and unemotional material is a

* This paper was edited, and the doctorate thesis, of which it is a condensation was directed by Dr. Joseph Tiffin, now of Brooklyn College, New York.

[1] Following Wilbur L. Schramm, "Approaches to a Science of English Verse," *Univ. of Iowa Studies,* No. 46, 1935, we distinguish three types of emphasis which are defined as follows:

1. Logical emphasis (referred to in this article by the single word *emphasis*) makes a word appear outstanding, or of greater importance than adjacent words, for purposes of meaning in the sentence. Thus when we read aloud "He is only a *child!*" we give logical emphasis to the word *child.*
2. Rhythmical emphasis, or stress, emphasizes a word or syllable in order to give a rhythm to the sentence. This type of emphasis is particularly important in poetry but is frequently used in prose as well.
3. Syllable emphasis, or accent, emphasizes a syllable in order to give the entire word its correct pronunciation.

This article deals with the first, or logical, type of emphasis.

[2] Kenyon, J., *American Pronunciation,* Menasha, Wis.: George Banta Publ. Co., 1924.

[3] Avery, E., Dorsey, J., and Sickels, N., *First Principles of Speech Training,* New York: D. Appleton, 1931; Bassett, L. E., *Handbook of Oral Reading,* New York: Houghton Mifflin, 1917.

function of pitch, time and intensity. Although the approach is different, the problem investigated is very similar to that studied by Parmenter and Blanc[4] and in some respects analogous to the investigation reported by Schramm.[5]

II. Procedure

Perceptual Analysis

Unemotional material. The basis of this part of the study was a sentence of factual material, 40 syllables in length, as follows:

> When does a house slowly emerging from a chaos of lumber, bricks and mortar, and taking on form and substance, cease to be merely a house and become a home?

The sentence, part of a paragraph, was read aloud by six men and nine women and recorded phonographically. Three Ss were staff members in the department of speech in the State University of Iowa; the remainder were majors in this department. The material was given to the Ss previous to the recording, sufficient time being given to allow each S to practice reading the paragraph before the record was made. The Ss knew nothing of the purpose of this investigation, and merely attempted to read the paragraph in a manner which best brought out the meaning and mood of the author.

The records were given to five judges, three men and two women, all graduate students in speech, with the following instructions:

> Here are phonographic records of a paragraph as read by 15 different speakers. Play the first sentence of each record several times and listen carefully to it. Then play it again as many times as necessary and rate each syllable according to the degree to which it "stands out" from the adjacent syllables, using a rating scale of from one to five. By the term "stand out," we mean any factor whatever in a syllable which reinforces it to bring out the meaning and mood of the author. The syllables which stand out most vividly should be rated five, those which stand out least should be rated one, and all others two, three and four, according to the degree of vividness which they possess for you.

Typewritten sheets containing the number of the record and the sentence to be judged were made out for each individual record and given to the judges. All the judgments were made when the judge was alone in a quiet room, free from distractions and interruptions.

[4] Parmenter, C. E., and Blanc, A. V. "An experimental study of accent in French and English," *Pub. of Mod. Lang. Ass'n. of Am.*, 48, 1933, 598–607.

[5] Schramm, Wilbur L., "Time and Intensity in English Tetrameter Verse," *Philol. Quart.*, 13, 1934, 65–71.

The syllables in each sentence were ranked on the basis of the perceptual analyses by taking the average of the five ratings. The average reliability of the judgments obtained by correlating each judge with every other judge by the Pearson product-moment formula was .81. In view of the fact that emphasis may be achieved in a number of ways, this correlation was considered sufficiently high to warrant the use of the composite ratings as a measure of the degree of emphasis on which psychophysical relationships might be based.

Emotional material. Two passages of dramatic material from the well-known plays *Candida* by Bernard Shaw[6] and *Strange Interlude* by Eugene O'Neill[7] were read by Margaret Wycherly and Gale Sondergaard respectively and recorded phonographically. The selection from *Candida* taken from the last act of the play was the long speech beginning with the sentences: "Sit down, dear. Let's talk about it like three friends . . ." and ending with the sentence "—Ah, I am mixing up your beautiful sentences and spoiling them, am I not, darling?"

The selection from *Strange Interlude* was a long soliloquy beginning with the sentences: "—that can't be my imagination . . . I felt it plainly . . . life . . . " and ending with the phrases: " . . . . there is no way . . . I am a mother . . . God is a mother."

Each syllable in the two passages was judged for emphasis in the manner previously described by five qualified persons, three of whom judged both passages. The average reliability of the judgments on *Candida* was .60, and on *Strange Interlude* .66. Explanation for these low reliabilities probably lies in the fact that emphasis used by professional actors is much more difficult to judge because of the increased subtlety and variability in the use of pitch, time and intensity factors. Using the average ratings of the five judges as the subjective stress values for the several words, as was done in this study, and estimating by the Spearman-Brown formula increases the reliability of the judgments on *Candida* to .88 and on *Strange Interlude* to .91.[8]

[6] Shaw, Bernard, *Candida,* New York: Brentano's, 1913.

[7] O'Neill, Eugene, *Strange Interlude,* New York: Boni & Liveright, 1928, 160–161.

[8] Remmers, H. H., Shock, N. W., and Kelley, E. L., in their article, "An Empirical Study of the Validity of the Spearman-Brown Formula as Applied to the Purdue Rating Scale," *J. Educ. Psychol.,* 18, 1927, 187–193, have shown experimentally that not only does the Spearman-Brown prediction hold true when

Physical Analysis

Having obtained a quantitative measure of emphasis on a subjective basis, the next step was to obtain quantitative measures of the physical factors in emphasis, *viz.*, pitch, time and intensity, in order to determine the psychophysical relationships between them. Pitch or melody curves were obtaiend by transcribing the sound waves on the phonograph records to a graphic record by an adaptation of the technique described by Metfessel.[9] Intensity records were made by means of a high speed output level recorder.[10]

The syllable was chosen as the basis of measurement throughout the experiment.[11] The syllables were grouped according to the degree of emphasis which they were judged to have, and the average pitch, time and intensity computed for each group. Pitch was measured in two ways, by averaging the deviations of the median pitch of each syllable from the median pitch of all the syllables[12] and second by the average extent of syllabic inflections. The musical step or tone was used as the unit of measurement in all pitch analyses. The direction of the pitch slide, stated in terms of per cent of syllables in each level of emphasis having the same types of inflection, also was noted.

A measurement of relative intensity was obtained by averaging the deviations in syllabic power from the mean syllabic power of all the syllables.

Time was measured by the deflection of the oscillograph element during the phonation of each syllable. Since one cm. on the film is equivalent to .1 sec., time was computed by measuring the duration of deflection on the base line in .1 cm. and converting this into secs.

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judges are used as the equivalent of test items, but that the formula predicts within two PE or one SD the empirical reliabilities obtained by experiment, up to and including 13 judges.

[9] Metfessel, M., "Technique for Objective Studies of the Vocal Art," *Psychol. Monog.*, 36, 1927, No. 1, 1–40.

[10] This recorder, similar in principle to the apparatus described by Hunt, F. V., "A Vacuum-tube Voltmeter with Logarithmic Response," *Rev. Scien. Instr.* 4, 1933, 672–675, has a response speed of approximately 750 db per second.

[11] An exception was made in the case of the word "chaos" in the unemotional material, which, because of the difficulty in delineating the two syllables on the intensity record, was treated as one syllable.

[12] In studying the emotional material, the average was substituted for the median because of the ease and accuracy with which it could be computed, and the fact that a frequency table of the average and median pitches showed a practically straight line relationship.

A measure of relative time was secured by averaging the deviations in time of each syllable from the average duration of syllabic phonation, thus eliminating individual differences in the speed of reading.

III. Results

It will be noted in the following presentation and interpretation of the results that the objective factors of emphasis considered in this study, *i. e.*, pitch, time, and intensity, show very similar types of distributions for both emotional and unemotional material. With few exceptions the distributions show definite differences between the means for each degree of emphasis. On the other hand, all of the distributions show wide dispersion for each level of emphasis, indicating that while there may be differences in these factors when the means of each group are compared, there may not be differences when individual syllables in one group are compared with those in another group. This is particularly true when the two groups being compared have adjacent rankings in emphasis.

Unemotional Material

Four measures were computed in the following way: without regard to the degree of emphasis, all syllables were combined to give the average duration of syllables in seconds, the average intensity in db, the median pitch, and the average extent of pitch inflection in musical steps. With these were compared the average duration, intensity, median pitch, and extent of inflection of each of the emphasis-groups. Thus it is seen in Table I that the average duration of the emphasized syllables[13] was .09 sec. greater than the average duration of all syllables, while those of least emphasis were .05 sec. less in duration than the general average. It is to be noted that these differences are smaller than the true differences because of the fact that

TABLE I

Deviation in Sec. of the Average Duration of Syllables of Four Degrees of Emphasis From the Average Duration of All Syllables Combined

Degree of Emphasis	N	Deviation from Mean Duration of All Syllables	S.D.	Range
4	73	.09	.083	—.08 to .38
3	143	.05	.084	—.12 to .40
2	70	.01	.065	—.15 to .20
1	205	—.05	.064	—.19 to .19

[13] Throughout the remainder of this report "emphasized sylables" will refer to those given a rating of 4, and "unemphasized" will refer to those given a rating of 1.

each emphasis-level is compared with the mean of all syllables, in the computation of which mean it has been a factor. If the syllables of greatest emphasis were compared with those of the remaining three emphasis-levels combined, a larger difference might be evident. Table I clearly shows a tendency for syllables to be prolonged in proportion as they are emphasized.

Intensity. With the exception of syllables given the two highest ratings, relatively large differences were found between the mean intensities of syllables given different degrees of emphasis (see Table II). Contrary to expectations, however, the range of the least emphasized syllables is approximately 2½ times as great as, and encompasses that of the most emphasized syllables. We may be justified in concluding from Table II, however, that there is a tendency for the emphasized syllables to have a greater average intensity than the unemphasized syllables.

Pitch. As in the case of intensity we find differences between the averages of the pitch deviations for all degrees of emphasis except those given the two highest ratings, the median pitch of the emphasized syllables being approximately one musical step higher than the median pitch of the unemphasized syllables (see Table III). So far as range is concerned, the findings are just the reverse of those found for intensity. Here the range of the emphasized syllables practically encompasses the range of the unemphasized syllables. The S.D.'s indicate that the least prominent syllables tend to concentrate about their mean while those considered most prominent scatter widely throughout the entire range.

Pitch inflection. The extent of syllabic inflection seems to show a much more consistent and significant relationship to emphasis than does the average syllabic pitch. The most highly emphasized syllables have an inflectional range which is over 2½ times as great, and an average syllabic pitch inflection which is approximately four times as great as that of the least emphasized syllables. This finding is a confirmation of the opinions of Bassett,[14] Avery, Dorsey and Sickles,[15] Woolbert,[16] and of the experimental findings of Merry[17] and Lynch.[18]

[14] Bassett, *op. cit.*

[15] Avery, Dorsey and Sickels, *op. cit.*

[16] Woolbert, C. H., *The Fundamentals of Speech* (rev. ed), New York: Harpers', 1927.

[17] Merry, G. N., "Voice Inflection in Speech," Thesis, University of Iowa, 1921.

[18] Lynch, Gladys, "An Objective Study of the Pitch, Time, and Intensity

Type of inflection. Differences of opinion also exist with regard to the type of inflection which is used to bring about emphasis. Therefore the form of the inflection used for each syllable was observed and the per cent of syllables in each emphasis group having the same type of inflection was computed. Only the major types of intonation were considered, *i. e.*, circumflex, inverted circumflex, compound circumflex, falling, rising, and level.

As shown by the physical analysis, there seems to be a tendency for the falling inflection to appear more often than any other type of intonation in all degrees of emphasis. Ranging next in frequency of use is the circumflex form for the most highly emphasized syllables, and level intonation for the least emphasized syllables. Root[19] states that "where there is a physically level pitch, the perceived unipitch is identical with the physical pattern. Rising and falling movements are heard as such or as a unipitch at some point along the slide." If this is true, the inflection as perceived probably does not differ a great deal from that shown on the melody curve. The findings of this study, therefore, are in direct opposition to Woolbert's[20] statement that "most syllables are given with the upward slide . . . the voice uses the upward slide nine times to once that it uses the downward or the wave." On the other hand they seem to agree in part at least with Meyer's[21] contention that "stressed vowels take a circumflex form and unstressed vowels a falling pitch movement."

Summary. The above results show that in the oral reading of factual material, emphasis is not a function of simple pitch, duration, or intensity, but rather that it is a function of an intricate relationship between all three of these factors. The wide dispersion of the scores, for the most and least emphasized syllables, precludes the possibility of drawing any definite conclusions concerning the relative contributions of each of these factors to emphasis. The results do show quite clearly, however, that the most and least emphasized syllables are more clearly differentiated by the factors of duration and range of syllabic inflection than by the factors of intensity and pitch level.

Factors in the Reading of Emotional and Unemotional Materials by Experienced and Inexperienced Readers," *Arch. of Speech,* 1, 1934, 9–25.

[19] Root, A. R., "Pitch Patterns and Tonal Movement in Speech," *Psychol. Monog.*, 40, 1930, No. 1, 109–159.

[20] Woolbert, *op. cit.*

[21] Meyer, L. A., "Zur Tonbewegung des Vokals im gesprochenen and gesungenen Einzelwort," *Phonet. Studien,* 10, 1897, 1–21.

This finding agrees with Bassett's[22] statement that "while every word in expressive speech has some inflectional variation, words in which the thought is most strongly centered are set out by inflections of greater range and duration, the range and duration varying according to the purpose of the speaker and the importance of the thought." Further research is necessary, however, before any conclusive statements may be made as to which factor is the most important.

Emotional Material

The analysis of emphasis used by the two actresses in the reading of dramatic material not only confirms the findings on non-dramatic material but shows an even greater consistency in the use of these factors in emphasized and unemphasized syllables.

Duration. A comparison of Tables VI and VII with Table I shows a striking similarity in the relative number of syllables judged to have different degrees of emphasis and in the decreasing range of duration with decreased emphasis.

The average duration of the emphasized syllables was .17 sec. longer in *Candida,* and .21 sec. longer in *Strange Interlude,* than the average duration of the unemphasized syllables.

These results confirm the findings on unemotional material: emphasized syllables have a longer duration than the unemphasized syllables.

Intensity. Turning to the factor of intensity, we find that with decreased emphasis there is a progressive decrease in the average intensity. In *Candida* the unemphasized syllables show a greater range than the emphasized syllables. Measurements of deviations from the mean intensity level show a tendency for the emphasized syllables to score positively and for the unemphasized to score negatively. In the reading from *Candida* the emphasized syllables have an average intensity which is approximately eight db greater than that of the unemphasized syllables. In *Strange Interlude* the difference is approximately 12 db in favor of the emphasized syllables.

From the above data and discussion, it would seem that intensity is a more significant factor in emphasis when dramatic material is used than when non-dramatic material is used but nothing in our results would warrant the statement that it is the most important factor.

Average syllabic pitch. The picture of the relationship between

[22] Bassett, *op. cit.*

emphasis and average syllabic pitch when emotional material is used (Tables X and XI) is very similar to that shown when unemotional material is used (Table III) so far as the general tendency for the pitch to decrease with emphasis is concerned, but the average pitch in emotional material is even more variable and the difference between the means less reliable. From the above tables it will be noted that the difference between the average syllabic pitch of the two extremes of emphasis is in each case approximately 1½ musical steps.

Pitch inflection. Contrary to the findings on syllabic pitch level, syllables given different degrees of emphasis seem to be quite clearly differentiated by the extent or range of their syllabic inflections. In both selections of emotional material the difference in the average range of intonation for the emphasized and unemphasized syllables was approximately 1.3 musical steps as contrasted with a difference of 1.9 musical steps found in the case of unemotional material. But whether dramatic or factual material is used, the average extent of syllabic inflection for the emphasized syllables was from 3½ to 4 times as great as the average extent for the unemphasized syllables.

Type of inflection. The results show that falling inflections are used more often in the reading of emotional material than any other type of intonation. Next in frequency is the circumflex type of inflection for the highly emphasized syllables and level or unipitch inflections for the least emphasized syllables.

If we combine all forms of circumflex inflection into one group, then the emphasized syllables are characterized by these complex intonations, with falling intonation ranking next in importance. Again we find a confirmation of the results on the unemotional material.

IV. Summary and Conclusions

A study of the relationship of pitch, time and intensity to emphasis in oral reading was made by phonographically recording a sentence of factual material, 40 syllables in length, as read by 15 trained Ss, and two passages of material from well-known plays, each read by a professional actress. Five qualified observers rated each syllable for emphasis, using a five-point scale. Based upon the average of the five judgments the syllables were divided into four groups, group four containing those syllables having the greatest emphasis, while group one contained those having the least. The phono-photographic technique was used to obtain objective measurements of pitch, time and intensity for each syllable.

The results seem to warrant the following conclusions:

1. In the oral reading of dramatic and factual material, emphasized syllables have a definitely longer duration than unemphasized syllables.

2. There is a tendency for the emphasized syllables to have a greater intensity than the unemphasized; this tendency is more apparent for the emotional than for the unemotional material.

3. Emphasized syllables in both types of material have a significantly wider pitch inflection than the unemphasized.

4. Whether dramatic or factual material is used, the emphasized syllables have a higher pitch level than the unemphasized.

5. In the oral reading of dramatic and non-dramatic material, there is a tendency to use the falling inflection more often than any other pitch pattern. Next in importance is the circumflex form of intonation for the emphasized syllables, and the level or unipitch for the unemphasized syllables.

6. Finally, the results of this study indicate that emphasis in oral reading is not a function of any one factor, but of a combination of pitch, intensity and duration. As to the relative importance of each of these factors, no definite conclusions can be drawn. On the basis of this study, all that can be said is that in the reading of dramatic and factual material, the most and least emphasized syllables are more clearly differentiated by the factors of duration and range of syllabic pitch inflection than by the factors of intensity and average pitch.

TABLE II

AVERAGE DEVIATION IN DECIBELS FROM THE MEAN INTENSITY LEVEL OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM MEAN INTENSITY OF ALL SYLLABLES	S.D.	RANGE
4	73	3.78	3.96	— 3 to 12
3	143	3.68	3.68	— 5 to 13
2	70	—.34	5.87	—15 to 10
1	295	—3.06	6.56	—26 to 12

TABLE III

AVERAGE DEVIATION IN MUSICAL STEPS OF THE MEDIAN SYLLABIC PITCH FROM THE MEDIAN PITCH OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM MEDIAN PITCH OF ALL SYLLABLES	S.D.	RANGE IN MUSICAL STEPS
4	73	.63	2.03	—4.0 to 4.8
3	141	.66	1.53	—3.2 to 5.2
2	67	.21	1.22	—3.3 to 2.8
1	282	—.31	1.27	—4.1 to 3.2

TABLE IV

AVERAGE EXTENT OF SYLLABIC PITCH INFLECTIONS, IN MUSICAL STEPS

DEGREE OF EMPHASIS	N	AVERAGE PITCH INFLECTION	S.D.	RANGE
4	73	2.48	1.6	0 to 6.4
3	141	1.10	.78	0 to 3.9
2	67	.89	.66	0 to 3.4
1	282	.61	.49	0 to 2.4

TABLE V

PER CENT OF SYLLABLES IN EACH EMPHASIS GROUP HAVING A GIVEN TYPE OF INFLECTION

	DEGREE OF EMPHASIS			
Type of inflection	4	3	2	1
Circumflex	22	28	14	6
Inverted circumflex	16	7	18	7
Compound circumflex	8	7	4	2
Falling	39	32	39	45
Rising	11	19	18	11
Level	4	7	7	29

TABLE VI

SELECTION FROM "CANDIDA"; AVERAGE DEVIATION IN DURATION OF SYLLABIC PHONATION FROM THE MEAN DURATION OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION IN SEC. FROM MEAN DURATION OF ALL SYLLABLES	S.D.	RANGE
4	34	.12	.12	—.07 to .56
3	130	.06	.08	—.12 to .29
2	171	.01	.08	—.15 to .35
1	160	—.05	.05	—.15 to .16

TABLE VII

SELECTION FROM "STRANGE INTERLUDE"; AVERAGE DEVIATION IN DURATION OF SYLLABIC PHONATION FROM THE MEAN DURATION OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION IN SEC. FROM MEAN DURATION OF ALL SYLLABLES	S.D.	RANGE
4	44	.14	.15	—.09 to .70
3	86	.07	.11	—.12 to .31
2	150	—.03	.06	—.17 to .22
1	88	—.07	.05	—.16 to .10

TABLE VIII

SELECTION FROM "CANDIDA"; AVERAGE DEVIATION IN DECIBELS FROM THE MEAN INTENSITY LEVEL OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM MEAN INTENSITY OF ALL SYLLABLES	S.D.	RANGE
4	34	6.5	5.27	— 3 to 15
3	130	2.5	5.61	— 7 to 15
2	171	— .97	4.34	—11 to 12
1	160	—1.6	4.52	—14 to 13

TABLE IX

SELECTION FROM "STRANGE INTERLUDE"; AVERAGE DEVIATION IN DECIBELS FROM THE MEAN INTENSITY LEVEL OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM MEAN INTENSITY OF ALL SYLLABLES	S.D.	RANGE
4	44	6.2	6.44	— 9 to 16
3	86	3.6	6.88	—12 to 19
2	150	— .9	6.62	—16 to 17
1	88	—5.5	6.41	—17 to 9

TABLE X

SELECTION FROM "CANDIDA"; AVERAGE DEVIATION IN MUSICAL STEPS OF THE AVERAGE SYLLABIC PITCH FROM THE MEAN PITCH LEVEL OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM AVERAGE PITCH OF ALL SYLLABLES	S.D.	RANGE IN MUSICAL STEPS
4	34	1.42	2.09	—3.4 to 4.5
3	130	.47	1.82	—3.5 to 4.4
2	171	.14	1.76	—4.1 to 5.0
1	160	—.04	1.67	—4.1 to 5.4

TABLE XI

SELECTION FROM "STRANGE INTERLUDE"; AVERAGE DEVIATION IN MUSICAL STEPS OF THE AVERAGE SYLLABIC PITCH FROM THE MEAN PITCH LEVEL OF ALL SYLLABLES

DEGREE OF EMPHASIS	N	DEVIATION FROM AVERAGE PITCH OF ALL SYLLABLES	S.D.	RANGE IN MUSICAL STEPS
4	44	1.23	1.56	—2.2 to 4.1
3	86	.5	1.50	—2.3 to 5.6
2	150	.20	1.77	—2.9 to 5.0
1	88	—.42	1.34	—3.5 to 4.0

TABLE XII

SELECTION FROM "CANDIDA"; AVERAGE EXTENT OF SYLLABIC INFLECTIONS, IN MUSICAL STEPS

DEGREE OF EMPHASIS	N	AVERAGE PITCH INFLECTION	S.D.	RANGE
4	34	1.7	1.11	.2 to 4.9
3	130	1.1	.81	0 to 5.3
2	171	.7	.57	0 to 2.7
1	160	.5	.52	0 to 4.6

TABLE XIII

SELECTION FROM "STRANGE INTERLUDE"; AVERAGE EXTENT OF SYLLABIC INFLECTIONS, IN MUSICAL STEPS

DEGREE OF EMPHASIS	N	AVERAGE PITCH INFLECTION	S.D.	RANGE
4	44	1.9	1.05	.3 to 4.4
3	86	1.4	1.05	0 to 5.6
2	150	.7	.54	0 to 2.7
1	88	.5	.54	0 to 3.3

AN EXPERIMENTAL ANALYSIS OF EMPHASIS

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I. Introduction

THERE has been considerable difference of opinion as to the nature of emphasis[1] employed in superior speech. Every textbook in the field of speech discusses the elements which are combined to yield effective emphasis. Some writers suggest the use of intensity as the most effective means of emphasizing or stressing certain words while others subscribe to pitch as the more basic element. Still others suggest the possibility of increased duration as the most effective means of obtaining emphasis. The majority of writers feel that a combination of these factors is present in the emphasis used by superior speakers.

It has been the object of this investigation to discover in an experimentally controlled situation the relationship between emphasis and (1) pitch, (2) intensity and (3) duration of the words.

II. Procedure and Technique

Since one of the main aims of this study was to secure material for pedagogical purposes, only trained speakers were chosen as Ss. Twenty speakers, nine men and eleven women, were used. The Ss were either members of the staff in the department of speech or graduate students of this department in the University of Iowa. All of the Ss were definitely above average in speaking ability. Each speaker was given two sheets of paper on which appeared typewritten instructions. The first page contained the following paragraph:

> You will be given a sheet of paper upon which specific directions are stated. In the directions the word, "stress," appears. By "stress" we mean anything which in your estimation will make the word appear outstanding. It is essential that you stress the proper word. Read the sentences aloud twice for practice.

[1] This article deals with logical emphasis, as defined by Ortleb. (Ortleb, Ruth, "An Objective Study of Emphasis in Oral Reading of Emotional and Unemotional Material," Speech Monographs, 4, 1937, 56–69.

The second page contained the material to be read and is reproduced below:

Please stress the word, Roosevelt!
President *Roosevelt* wants all men to be loyal to the nation.
Please stress the word, All!
President Roosevelt wants *all* men to be loyal to the nation.
Please stress the word, Men!
President Roosevelt wants all *men* to be loyal to the nation.
Please stress the word, Loyal!
President Roosevelt wants all men to be *loyal* to the nation.
Please stress the word, Nation!
President Roosevelt wants all men to be loyal to the *nation*.

The performance of each speaker was recorded on an aluminum disc phonograph record. Pitch curves for the twenty voices were obtained by means of the technique described by Tiffin.[2] Intensity curves were obtained from the phonograph recordings by means of an adaptation of the apparatus described by Hunt.[3] Duration measurements were obtained from the intensity records.

Comparisons were made between each word when stressed and the four unstressed repetitions of the same word. These comparisons were made with reference to the following measures: (1) Average intensity. The intensity level of the word in db above or below the average intensity of the sentence. This procedure made it possible to compare words in sentences spoken at different intensity levels. (2) Duration of phonation. The duration of phonation of each word measured in terms of its deviation from the average length of the words in that particular sentence. (3) Average pitch level. The difference in semi-tones between the average pitch of the word and the average pitch level of the sentence in which it occurs. (4) Highest pitch level. The difference between the highest pitch reached during the word and the average pitch level of the sentence. (5) Lowest pitch level. Same as (4) except that the lowest instead of the highest pitch reached during the word was considered. (6) Magnitude of inflection. The difference in semi-tones between the highest and lowest pitch reached during the word. (7) Type of inflection. The classification of inflections according to the pattern of pitch movement.

[2] Tiffin, Joseph, "Applications of Pitch and Intensity Measurements of Connected Speech, *J. Acoust. Soc. Am.*, 5, 1934, 225–234.

[3] Hunt, F. V., "Vacuum Tube Voltmeter with Logarithmic Response," *Rev. of Scientific Instruments*, 4, 1933, 672–675.

TABLE I

SUMMARY ANALYSIS OF THE MEASURES APPLIED TO THE SAME WORDS STRESSED AND UNSTRESSED

MEASURE	N	STRESSED WORDS MEAN	S.D.	N	SAME WORDS UNSTRESSED MEAN	S.D.
1. Average pitch level above (+) or below (—) average pitch of sentence	100	.8 semi-tones	2.1	400	0.0 semi-tones	1.7
2. Highest pitch above (+) or below (—) average high pitch of sentence	100	3.5 semi-tones	2.2	400	.6 semi-tones	1.9
3. Lowest pitch above (+) or below (—) average low pitch for sentence	100	—2.0 semi-tones	3.5	400	—.2 semi-tones	2.1
4. Magnitude of inflection	100	8 semi-tones	3.5	400	3.3 semi-tones	1.8
5. Intensity above (+) or below (—) average intensity level for sentence	100	9.3 db	5.9	400	3.2 db	5.5
6. Average duration above (+) or below (—) average duration of other words in sentence	100	.26 sec.	.12	400	.10 sec.	.11

III. RESULTS

The results of the first six measures are summarized in Table I, and are explained in the following paragraphs:

Average pitch level. The average pitch of the 100 stressed words in this study was .8 of a semi-tone higher than the average pitch level of the respective sentences in which they appeared. The average pitch of the 400 unstressed words studied was the same as the average pitch for the sentence. Thirty-nine per cent of the stressed words were higher in average pitch than the same words unstressed. Nineteen per cent of the stressed words were lower in pitch level than the same words unstressed.

Intensity. The average intensity of the 100 stressed words was 9.3 db higher than the average of the respective sentences in which they appeared. These same words, when unstressed, showed an average intensity only 3.2 db greater than the average of the sentence. The fact that these particular words received somewhat more than average intensity, even when not stressed, is probably due to their relatively great importance in the sentence. Seventy-one per cent of the stressed words showed more intensity than the same words when unstressed.

Duration of phonation. The average duration of the stressed words is not a particularly meaningful measure due to the fact that

the several words studied do not contain the same number of syllables nor the same vowels. The duration of the several words will naturally vary because of these factors. This difficulty was surmounted by limiting the comparison to the stressed and unstressed repetitions of the same words. It was found that 98 per cent of the stressed words were of greater duration than the same words when unstressed.

Highest pitch level. The average highest pitch of the 100 stressed words was 3.5 semi-tones higher than the average high pitch of the other words of the sentence. The average high pitch of the 400 unstressed words was .6 of a semi-tone higher than the corresponding average for the other words in the sentence. Seventy-five per cent of the stressed words were higher in the highest pitch reached than the same words when unstressed.

Lowest pitch level. The average lowest pitch reached of the 100 stressed words was 2 semi-tones lower than the average low pitch of the remaining words in the sentence. The average low pitch of the 400 unstressed words was .2 of a semi-tone lower than the corresponding average for the remainder of the sentence.

Magnitude of inflection. The average magnitude of inflection of the 100 stressed words was eight semi-tones. The corresponding average for the 400 words when unstressed was 3.3 semi-tones. Eighty-four per cent of the stressed words had greater magnitude of inflection than the same words unstressed.

TABLE II

ANALYSIS OF THE TYPE OF INFLECTION USED FOR THE STRESSED WORDS AND THE SAME WORDS UNSTRESSED

TYPE OF INFLECTION	STRESSED WORDS PER CENT OF OCCURENCE	UNSTRESSED WORDS PER CENT OF OCCURENCE
IC, R	1%	3%
F, IC	1%	5%
R	1%	4%
F	2%	10%
C	4%	5%
C, F	30%	9%
R, C	9%	8%
C, R	19%	14%
IC, C	5%	6%
IC, IC	6%	7%
C, C	12%	11%
Miscellaneous	10%	18%
Total	100%	100%

C — circumflex
IC — inverted circumflex
F — falling
R — rising

Duration of words. The stressed words were on the average .26 seconds longer in duration than the remainder of the words in the sentence, whereas the same words unstressed were only .10 seconds longer. Ninety-eight per cent of the stressed words were longer in duration than the same words when not stressed.

Type of inflection. Table II shows the relative frequency of certain inflectional patterns for the stressed and unstressed repetitions of the words. Of the several types, the one which most markedly differentiates the one class of words from the other is the CF (circumflex followed by a falling inflection) which appears in 30 per cent of the stressed words but only nine per cent of the unstressed. Except for this pattern, and to a lesser extent the CR (circumflex followed by a rise), the type of inflection seems to have little relation to emphasis.

The fact that several of the elements studied seemed to be related to emphasis points to the conclusion that, under normal cricumstances, emphasis is achieved by a combination of several factors rather than by one element. The data were re-examined, and Table III continued in the light of this hypothesis. In constructing this table, it was considered that intensity, magnitude of inflection, average pitch level, type of inflection or duration was employed if the measurement of the element showed a greater value for the stressed word than for the corresponding value for the unstressed repetition of that word. The lowest pitch reached was considered to be employed if the value was lower than the corresponding value for the unstressed repetitions of the word. Type of inflection was considered as important if the pattern most frequently present on stressed words, *i. e.*, a circumflex followed by a falling inflection, was found. This table shows that the number of elements employed varies from one to seven, the mode being at *five*. Eighty-nine per cent of the stressed

TABLE III

THE NUMBER OF BASIC ELEMENTS EMPLOYED DURING EMPHASIS

NUMBER OF ELEMENTS	PER CENT OF OCCURENCE
1	2%
2	3%
3	6%
4	25%
5	41%
6	19%
7	4%
	Total 100%

words employed four or more of the basic elements analyzed in this study.

IV. Summary and Conclusions

The speech of 20 trained speakers speaking five repetitions of a given sentence, each time stressing a different word, was recorded and analyzed to determine the relationship between stress and the pitch, intensity, and duration of the word emphasized. Comparisons were made between the measurements from the stressed and unstressed repetitions of the same words. The results show the stressed words to differ from the unstressed repetitions of the same words in the following respects:

1. In 98 per cent of the cases they were of longer duration.
2. In 84 per cent of the cases they showed a greater magnitude of inflection.
3. In 75 per cent of the cases, they reached a higher pitch.
4. In 74 per cent of the cases they were more intense.
5. In 71 per cent of the cases they reached a lower pitch.
6. In 39 per cent of the cases they were higher in average pitch and in 19 per cent of the cases they were lower in average pitch.

The order of the above six elements probably indicates the order of their importance in determining emphasis. The results also indicate that

7. The inflectional pattern is probably of small importance in determining emphasis, inasmuch as no single type of pattern is found in over 30 per cent of the stressed words.
8. A combination of factors, rather than a single element, is the rule in obtaining emphasis, since in the great majority of cases, 89 per cent, four or more of the basic elements were employed on the stressed words.

Bibliography

1. Hunt, F. V., "Vacuum Tube Voltmeter with Logarithmic Response," *Rev. of Scientific Instruments*, 4, 1933, 672–675.
2. Ortleb, Ruth, "An Objective Study of Emphasis in Oral Reading of Emotional and Unemotional Material," Speech Monographs, 4, 1937.
3. Tiffin, Joseph, "Applications of Pitch and Intensity Measurements of Connected Speech," *J. Acoust. Soc. Am.*, 5, 1934, 225–234.

RELATION BETWEEN HAND AND VOICE IMPULSE MOVEMENTS*

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I. Development and Purpose of the Present Study

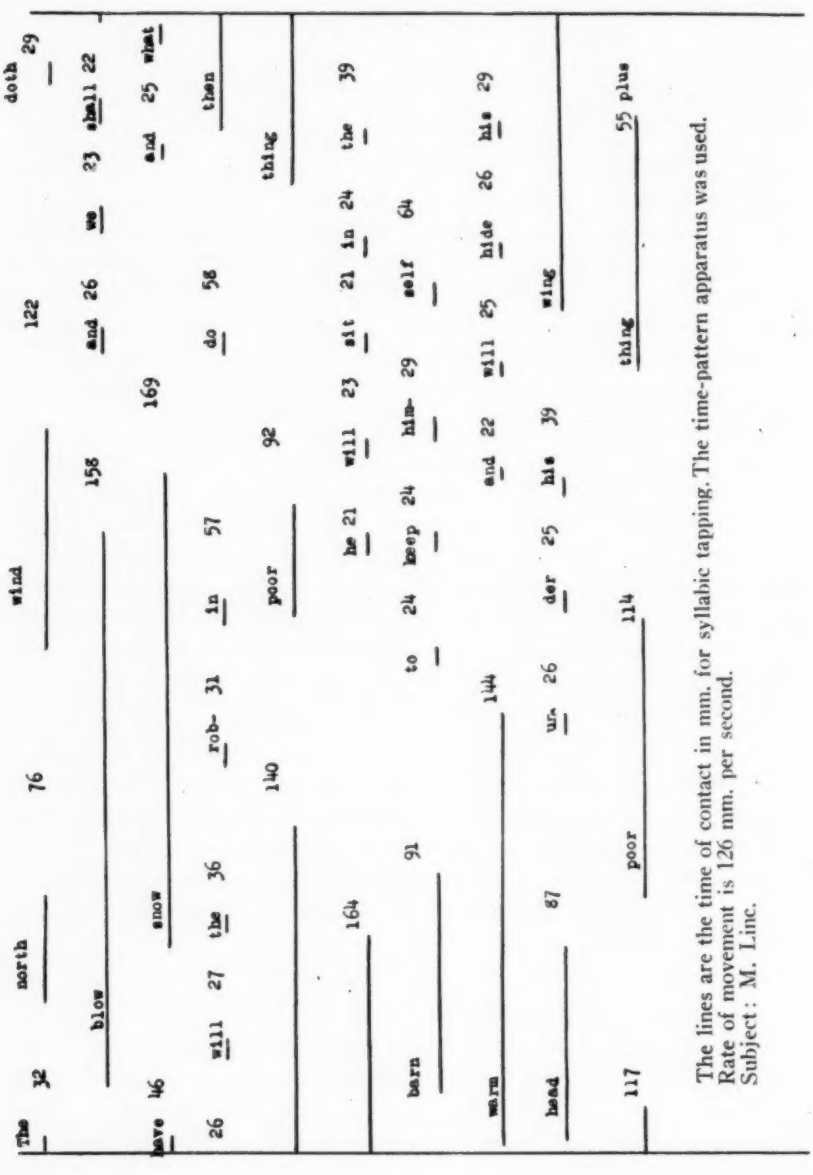
THIS investigation goes back to an early interest in the graphic representation of the use of time in speaking. A crude graphic representation was first made by moving the hand at an approximately uniform speed in front of a blackboard, and at the same time tapping with a piece of chalk against the board for each syllable spoken. The result was a succession of lines and spaces of varying length. It was seen that this pattern could be made exact by tapping with a marker on paper moving at a uniform speed. Apparatus was devised and many records made. One of these records, changed into page form for convenience in printing, is illustrated on the next page. This type of time-pattern does not tell enough of the whole tapping movements, so apparatus was made to record the continuous movements of the hand in syllabic tapping. A reduced copy of six of these records is illustrated in Plate 1. The lines were made by fountain pens on moving adding machine paper. The curved lines represent the hand movements. The straight lines cutting through the curves are base lines. The other straight lines are places where the separate records were pasted together. A rise in the curve represents a downward movement of the hand. The curves show that a tap tends to be held until the next tap is needed. This indicates that impulse movements in the hand are part of attention and meaning, and that variations in time and intensity of taps are not due primarily to the phonetic character of the syllables produced, nor to dominance of motor rhythm in tapping, but come from the meaning involved. The curves also show a marked similarity of pattern for different speakers recording the same selection.

Experiments carried on showed that normal persons, when told to tap while speaking, tend to tap once for each syllable clearly uttered. Out of the twenty-six untrained persons told merely to tap while reading aloud, all but four showed a marked tendency to tap

* Complete data upon which this paper is based is on file in the Library of the University of Michigan.

TIME-PATTERN OF SYLLABIC TAPPING

SHOWING THE DURATION OF THE CONTACT AND THE RELEASE IN TAPPING. SCALE 2/3.


The 32 north 76 wind 122 doth 29
blow 158 and 26 we 23 shall 22
have 46 snow 169 and 25 what
26 will 27 the 36 rob- 31 in 57 do 58 then
140 poor 92 thing
164 he 21 will 23 sit 21 in 24 the 39
barn 91 to 24 keep 24 him- 29 self 64
warm 144 and 22 will 25 hide 26 his 29
head 87 ur- 26 der 25 his 39 wing
117 poor 114 thing 55 plus

The lines are the time of contact in mm. for syllabic tapping. The time-pattern apparatus was used.
Rate of movement is 126 mm. per second.
Subject: M. Linc.

PLATE 1—ILLUSTRATION OF CURVES OF HAND TAPPING. SCALE 1/3.

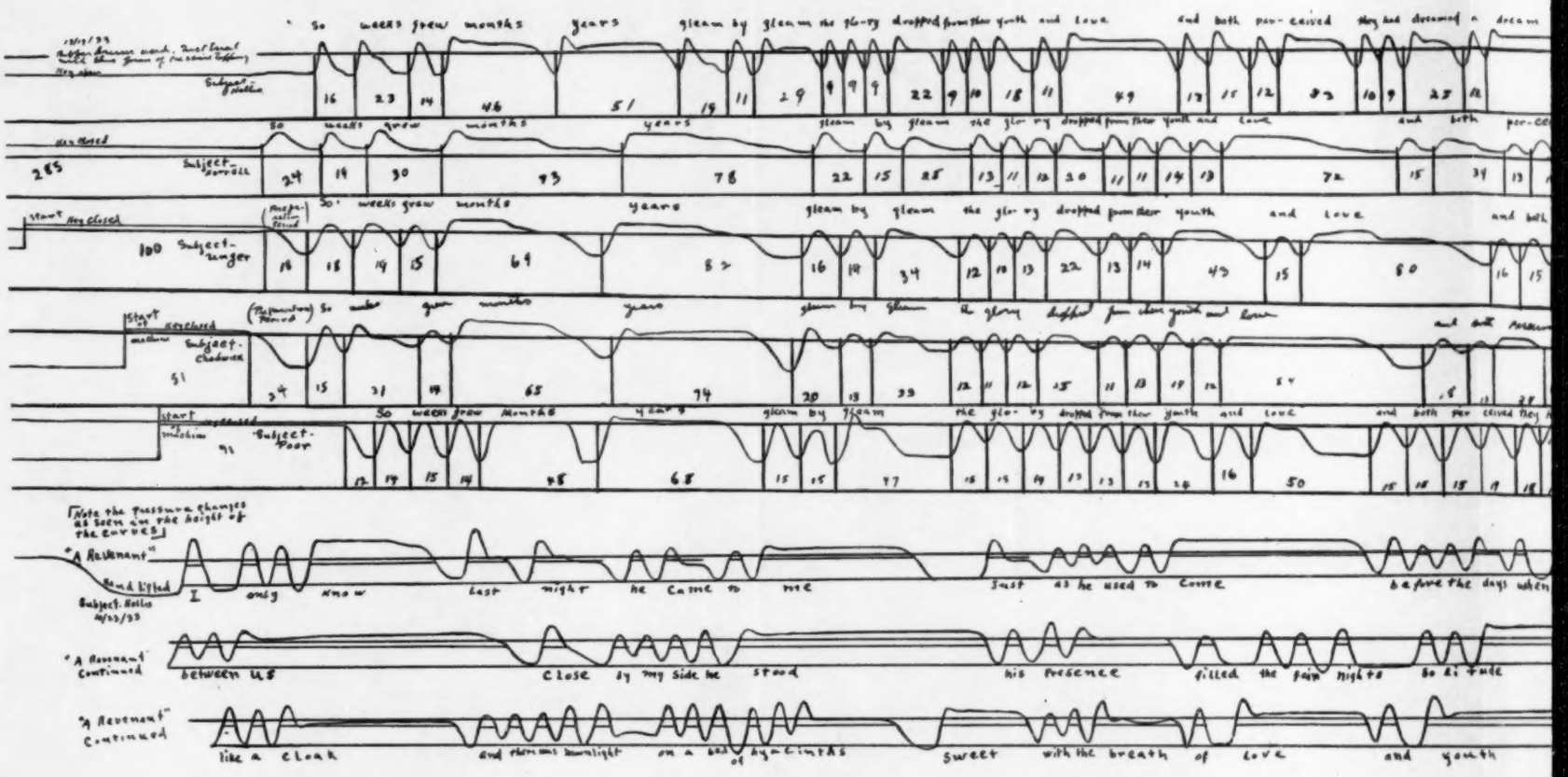
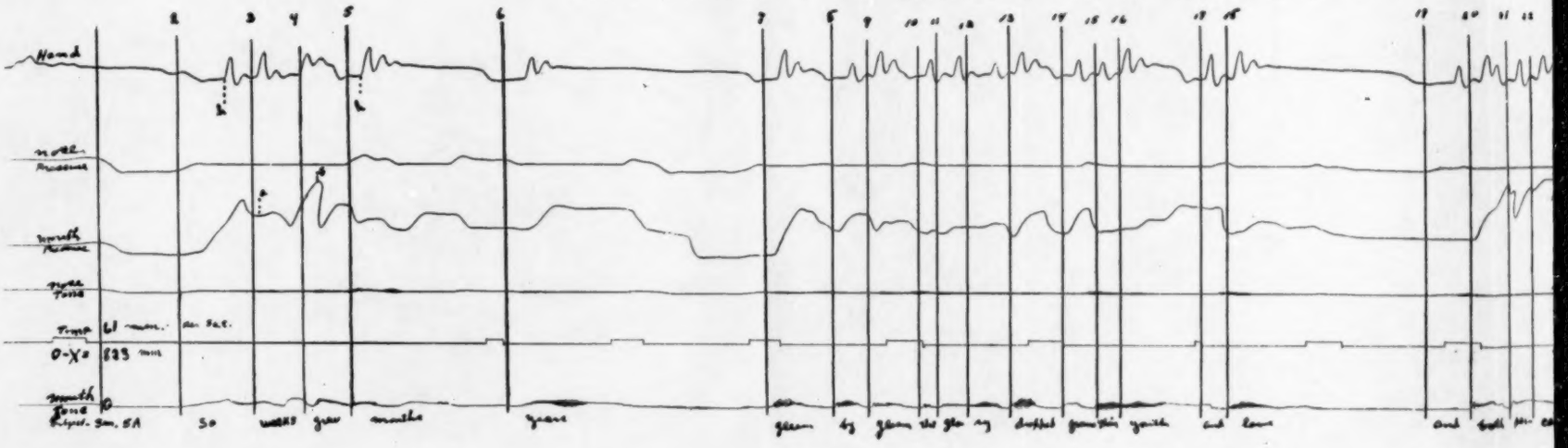
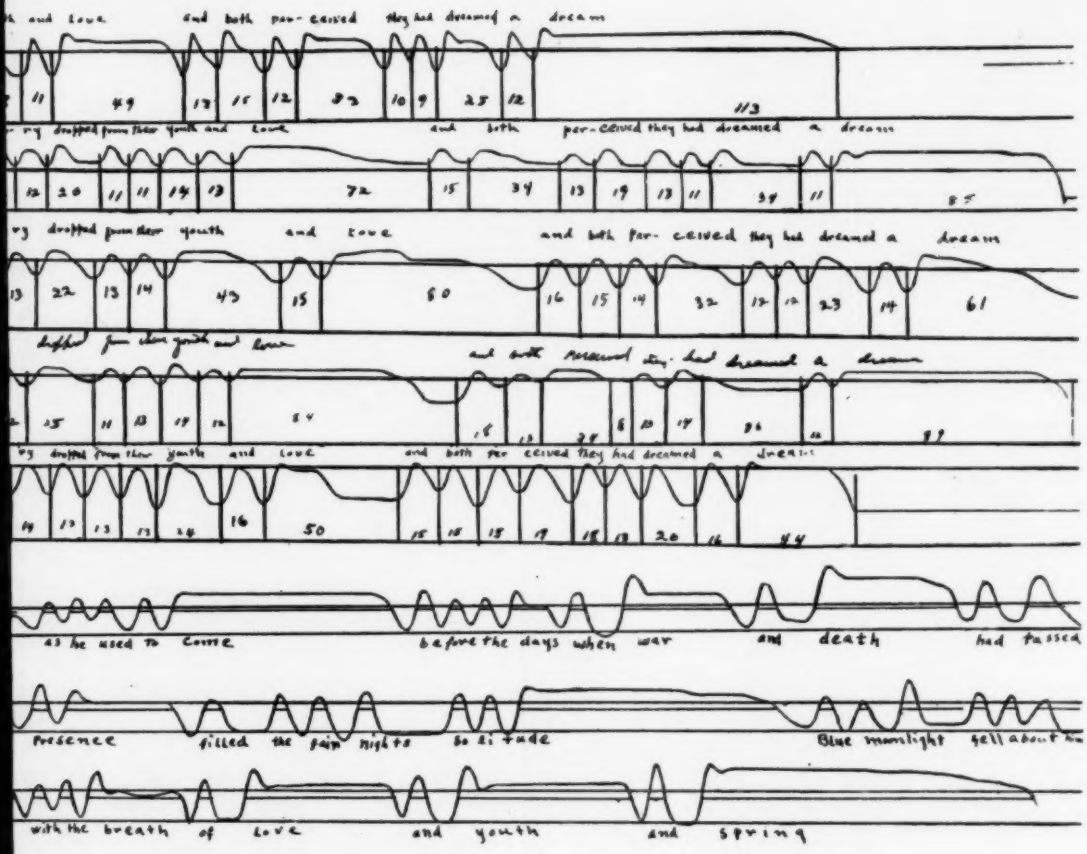

So weeks grew months years gleam by gleam the glory dropped from their youth and love
Subject—Hollis
Subject—Carroll
Subject—Singer
Subject—Chadwick
Subject—Poor
(Preparatory Period)
"A Remnant"
I only know last night he came to me just as he used to come before the days when
"A Remnant" Continued
between us close by my side he stood his presence filled the pale nights so still
"A Remnant" Continued
like a cloak and thro' the moonlight on a bed of hyacinths sweet with the breath of love and youth

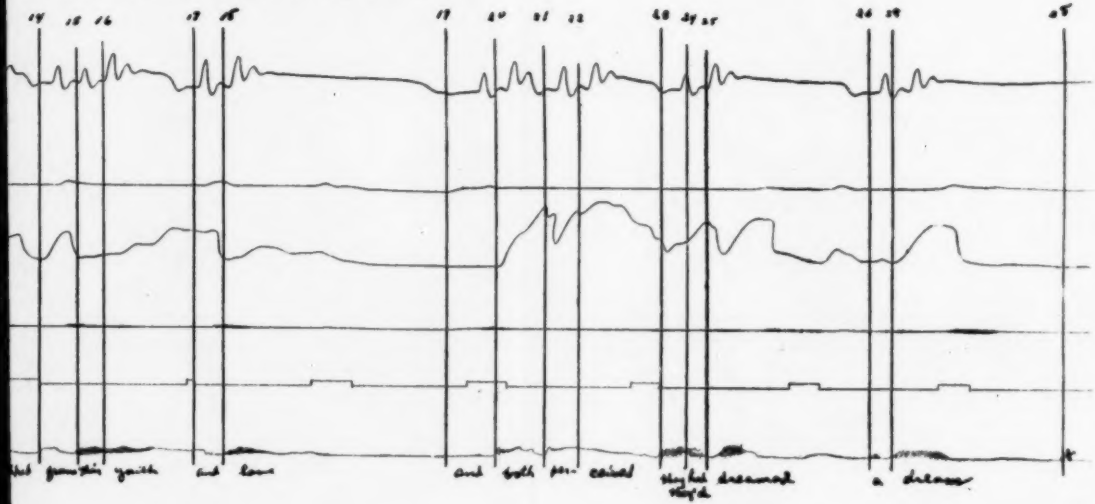
PLATE 7—ILLUSTRATIONS OF A KYMOGRAPHIC RECORD OF HAND AND VOICE MOVEMENTS. SCALE 1/3.



OF HAND TAPPING. SCALE 1/3.


and love
and both per- ceived they had dreamed a dream
and both per- ceived they had dreamed a dream
and both per- ceived they had dreamed a dream
and both per ceived they had dreamed a dream
as he used to come
before the days when war and death had passed
presence filled the pain nights so lit ude
Blue moonlight fell about
with the breath of love and youth and spring

D OF HAND AND VOICE MOVEMENTS. SCALE 1/3.



once for each syllable uttered. With a little practice many persons not only tap once for each and every syllable clearly uttered, but do so without distraction from the thought and often without consciousness of tapping. These experiments made it important to test the relation beween the hand and voice impulse movements. For such a test simultaneous records of these movements were needed. Such a test would determine whether or not records of active tapping during speaking, similar to those in Plate 1, are by themselves scientifically valid records for the study of impulse movements in a thinking-speaking process.

II. The Apparatus

It was essential that the apparatus should give clear, simultaneous records of the following: the voice tones through the mouth and through the nose; the air pressure through the mouth and through the nose; the hand action during the speaking; the time and duration of these occurrences, and a dictaphone record for checking on what was actually said. The apparatus and conditions of recording should permit the subject to adapt himself quickly, and to keep his attention on the meaning of the literature spoken. A kymograph was used. Sensitive tone-recorders were made with drumheads of goldbeater's skin. A mouthpiece was made with flexible rubber dam about the mouth and nose to minimize interference with speech movements. A hand-impulse board was made with two tambour boxes covered with heavy rubber, one tambour to record movements at the heel of the hand, the other at the fingertips. Suitable transmission tubes and dictaphone connections were used.

III. Making the Records

The subjects used were ten men. Some were skilled in speaking, others had had relatively little training. They were not informed of the real purpose of the investigation, and had not had instruction or training in syllabic tapping or tapping during speaking. In making the records, the subject was curtained from the kymograph and operator. He sat in a straight chair with his right side towards the apparatus, held the mouthpiece before his mouth with his left hand, rested his right forearm comfortably upon the hand-recording board, unless otherwise instructed, and could look out of the window. Each subject made ten records of each of two excerpts from literature, under the following different conditions of readiness-for-action. Record 1. The subject sat back in the chair, forearm resting on the

hand-recording board, fingertips and heel of the hand resting with active sense of touch on the two tambours. Record 2. Same as Record 1, except the heel of the hand was raised. Record 3. Same as 2, except the whole arm was raised, thus increasing the pressure on the fingertips. Record 4. Same as 3, except the subject leaned forward from the back of the chair in a more active position. In these first four records, there was no intentional attempt to move the hand. Record 5. Same as Record 3, except the subject was told to tap while speaking but was not told how to tap. Record 6. Same as 5, except the subject was told to tap once for each syllable he spoke. Records 7 and 8. Same as 6, except the subject had practiced occasionally for a few days. Records 9 and 10. Same as 7, except the subject was told to use pressure response instead of tapping. Detailed mimeographed instructions were given to each subject. In the first instruction sheet, the subject was asked to read and study parts of Browning's *The Statue and the Bust,* and to memorize the lines. "So weeks grew months, years; gleam by gleam the glory dropped from their youth and love, and both perceived they had dreamed a dream." This was *Selection A.* Subjects also studied Act III, Scene 4, from *Macbeth* and memorized the lines, "Hence, horrible shadow! Unreal mockery, hence!" This was *Selection B.* Lines just preceding these excerpts were to be memorized also. When the subject came to make the first records, he was trained in the use of the mouthpiece, and given printed instructions on how to sit and what to do in making each of the first six records. After a few days of self-training in tapping while speaking, the subject was given instructions for making the last four records. These instruction sheets are in the complete dissertation.

IV. Illustration of the Records

Plate 7 illustrates one of the kymographic records made. In this record, intentional but undirected tapping was recorded. The general relation of hand stroke to voice stroke is evident.

V. Measurement and Analysis of Records

Impulse may be thought of either as a single motor stroke or as a succession of motor strokes bound together in a single sweep of changing energy. Thus, striking a nail on the head once may be regarded as a single motor impulse, while hitting it repeatedly until it is driven home is a single purpose impulse. Each syllable in speak-

ing is a motor impulse unit. A succession of syllables united by meaning is a thinking impulse unit. Oneness in the fixation and surge of energy is the essential of an impulse unit. In speaking, whether we consider a single syllabic stroke or the more complex surge of energy in a thinking unit, certain characteristics of the impulse are the same. (1) There is a singleness of aim and effort in the use of energy. (2) The energy of impulse is dynamic; always rising, sustaining itself, or falling, never static or dead. There is a period of readiness-for-action, a time of pursuit, a moment of hit, a period of hold, a time of relaxation and release. This fact makes an impulse in itself a movement process; just as there is movement in a meaningful succession of impulses. (3) The energy of the impulse has one dominating climax which unifies the supporting fluctuations of energy.

The basic unit of impulse to be measured and compared is the stroke of the hand and the syllabic stroke of the voice during a thinking process. It should be recognized that a syllabic impulse and a syllabic sound are not necessarily the same. The syllabic impulse may start before the sound starts and last long after the sound is completed. It is the syllabic impulse, or the whole mental-motor state that surrounds the actual sound, that is to be measured.

In marking the syllabic impulse units, perpendicular lines were placed at what was judged to be the limits of these units. The evidence in the records indicated that there were no dead places between impulses. The four parts of the voice and breath records were the means of determining these lines. Very careful effort was made to locate these lines with accuracy. The technique and details are described in the complete dissertation. The distance between lines, measured in millimeters, gave the time length of each syllabic impulse in the two hundred records made.

VI. Results

The results obtained are presented under the five general heads that follow. Measurements in the tables are in millimeters unless otherwise indicated. The speed of recording was 61 millimeters per second. It was not necessary, however, to change measurements from millimeters into seconds.

A. Occurrence of Hand Impulse with Voice Impulse on Syllabic Units or Phrasal Groups.

Two types of response in the hand during speaking were measured;

the phrasal surge response and the syllabic stroke response. In Records 1-4, where there was no intentional tapping, the unconscious hand response was of the phrasal surge type. To measure this pressure response, the number of syllables involved in the hand movements recorded on the records were counted. These numbers are given in Table P-11. They indicate an increasing surgal response in the hand as the readiness-for-action increases from Record 1 to Record 4. It is to be noted that on Record 4, *Selection A,* the hand response covered 70% of all syllables, and in *Selection B,* 97% of all

TABLE P-11

SUMMARY OF THE NUMBER OF SYLLABLES INVOLVED IN THE PHRASAL RESPONSES OF THE HAND DURING RECORDS 1–4

RECORD / SUBJECT	SELECTION A 1	2	3	4	SELECTION B 1	2	3	4
Fr.	0	16	3	24	7	12	12	12
Di.	0	1	20	26	11	12	12	12
Re.	25	26	22	24	12	12	12	12
Sa.	0	15	13	10	0	12	6	10
St.	0	2	x	22	11	1	12	x
Ha.	5	8	6	0	12	7	9	12
Mc.	0	17	26	26	0	9	9	12
Gr.	0	9	0	0	0	0	12	12
Pa.	24	26	22	26	11	6	7	12
Sm.	19	21	26	24	8	12	12	12
Av.	7.3	12.5	15.3	18.2	8.2	8.3	10.3	11.6
				70%				97%
	Total number of syllables per record is 26.				Total number of syllables per record is 12.			

syllables. The higher percentage for *Selection B* is undoubtedly due to its greater emotional content. It should be remembered that these were unconscious and unintentional responses in the hand.

Table P-12 summarizes the number of syllables tapped for Records 5–8 in which active tapping was used. It will be noted that in Record 5, which was made without any instruction to tap syllables, or any consciousness that syllables were being tapped, the percentage of syllables tapped is 93.2 for *Selection A* and 84.1 for *Selection B.* This shows clearly the high degree of natural coordination between the tapping impulse and the syllabic impulse in active tapping during speaking. In making the measurements for Table P-12, a single tap with a syllable was marked 1, two taps or other uncertainty was marked ½, and no tap on a syllable was marked 0.

B. Closeness of Synchronization Between the Hit of the Hand and the Hit of the Voice.

General examination of records, such as that illustrated in Plate 7 seemed to show a very close synchronization between the hit of the hand and the hit of the voice. To determine the degree of this synchronization, Records 5 and 8 for six subjects were measured. These records were regarded as typical. Record 5 was undirected tapping and Record 8 was the last of the directed tapping records. Measurements in millimeters were made from the beginning of each impulse unit to the beginning of the mouth tone and to the beginning of the

TABLE P-12

SUMMARY OF OCCURENCE OF HAND STROKE WITH SYLLABIC UNITS FOR RECORDS 5–8

RECORD SUBJECT	SELECTION A				SELECTION B			
	5	6	7	8	5	6	7	8
Fr.	22½	22	23½	22½	11	11½	12	12
Di.	24	24	22	22	x	12	11	12
Re.	26	25	24	25	x	9½	9½	11
Sa.	x	24	23	24	x	10½	10½	11½
St.	19	22½	21	26	9	11	9½	11
Ha.	26	24½	25	24	10	11	11	11½
Mc.	25	25	26	26	8	12	12	10
Gr.	24	25	23	20	x	11	11	11½
Pa.	25	23½	25	25½	12	11	10	11½
Sm.	25	24	26	26	11	11	11½	12
Av. % per record...	93.2	91.9	91.5	93	84.1	92	90.8	95

Total average for records 5–8, Selection A, 92.6%; Selection B, 91.9%.

hit of the hand. The first measurement was subtracted from the second. The difference indicates the closeness of synchronization. Table T-5 summarizes these differences. The minus signs mean that the moment of hit of the hand came before the beginning of the voice tone. In this table the impulse units which show a predominance of minus signs are *so*, the second *gleam*, *per*, and *ceived*. The average time with which the hand hit precedes the opening of the mouth tone in these units is .065 seconds. While this is relatively very small there is a reason for it. To illustrate, the breath pressure curves in the records show a strongly rising pressure before the break of the vowel *o* in the *so* unit. This comes during the preparation for the *s* sound. There is a skyrocketing effect in producing this syllable. It is probable that the feeling of climax, or tenseness of articulatory position, comes on the *s* just before the opening of the *o*. The units that

show a predominance of plus signs are *weeks, years, youth.* Each of these has an ascending energy after the mouth tone starts. This is plainly seen in the increasing amplitude recorded in the mouth tone after the mouth tone starts. The average time that the hit of the hand comes, after the opening of the tone is as follows: *weeks*—.103 sec., *years*—.047 sec., *youth*—.040 sec. The *w* sound in *weeks* is more easily continued than the *y* sound in *years,* and the *ks* is explosive. This throws the moment-of-hit late in this unit.

Measurements show that the synchronization between the moment-of-hit of the hand and that of the voice is very close for normally coordinated individuals, and that the moment of hit of the hand comes at that point in a syllabic unit where the energies of breath pressure, vocalization, and articulatory stroke combined, reach their moment of climax. In general, this seems to be at the break of the strong vowel, or at the moment of explosion or strike in the use of breath pressure and articulatory action. The moment of climax in

TABLE T-5

*Summary of Differences Between Voice Impulse and Hand Impulse. Selection *A* Records 5 and 8

Subject / Record	Di		Ha		Mc		Re		Pa		Sm	
	5	8	5	8	5	8	5	8	5	8	5	8
So	0	—1	—4	—8	—8	—4	0	—6	0	—2	—5	—11
weeks	7	8	3	—3	14	10	4	0	10	0	2	7
grew	0	0	—2	—7	3	3	—3	—4	1	—2	—4	0
months	—2	1	—6	—6	0	0	0	—5	1	4	4	—2
years	—9	0	0	2	—6	0	2	2	6	7	4	6
gleam	0	0	0	—7	0	0	2	0	—2	—2	4	2
by	—4	—3	3	—6	—7	—5	9	—6	8	0	6	1
gleam	—8	—3	—4	—7	—7	—5	0	—5	1	—4	1	0
the	7	4	—6	0	—10	—5	4	1	0	—4	1	—2
glo-	7	4	—4	3	0	0	0	0	5	0	4	0
ry	14	x	2	x	x	3	x	x	11	18	7	0
dropped	1	—1	x	—7	—3	0	2	—4	2	7	2	—2
from	—6	0	—4	0	0	0	0	0	6	0	0	—2
their	0	10	—1	3	—7	0	1	0	x	4	1	2
youth	2	5	3	1	0	5	3	0	4	1	0	0
and	0	5	0	0	—2	0	0	0	x	0	0	0
love	—1	x	?	x	0	0	0	0	3	0	3	—4
and	x	x	—3	—1	—4	—2	—3	3	0	—2	0	0
both	—5	0	—3	0	0	—1	—4	0	0	0	4	0
per-	—10	—3	—6	—3	—2	—4	—6	—8	4	0	2	—3
ceived	—10	—4	—5	—7	—7	—4	—10	—8	—6	—4	0	—4
they	6	0	—3	—12	—7	—4	0	—3	—5	9	7	—1
had	x	x	0	x	0	0	1	2	6	4	?	3
dreamed	—6	—5	—4	—12	1	—1	—4	2	0	—8	—4	3
a	0	x	0	—6	—7	—4	—2	0	2	—1	4	2
dream	—3	—2	0	—6	—2	0	—3	—4	0	0	6	8

*Taken from Tables T-1 to T-4.

the voice impulse does not necessarily come at the opening of the tone, but may precede or follow it, depending upon the nature of the sounds uttered, the relation of these sounds in the flow of speech, and the meaning involved. The average variation from simultaneity between the beginning of the hit of the hand and the beginning of the mouth tone in Table T-5 is plus or minus .020 seconds. In only 2% of the units does this variation run as high as from .160 to .290 seconds.

C. Influence of Active Tapping upon the Time-Pattern of Impulse Movement in the Voice.

Even though the hand impulse in active tapping during speaking does occur with the voice, and even though the synchronization between the moment-of-hit of the hand and the voice is very close to simultaneity, yet if such tapping tends to weaken or destroy the normal time-pattern of impulse movement in a thinking-speaking process, then records of active tapping during silent or oral speaking cannot be used as adequate records by themselves for a scientific study of impulse movement. To determine whether or not active tapping during speaking does tend to weaken or destroy the normal time-patterns of speaking, the impulse units in all of the two hundred records were measured. A sample of these measurements is given in Tables M-10 and N-10. The averages of measurements for Records 1 to 4 were compared with those of Records 5 to 8, and Records 9 and 10. These are given in Tables S-1 and S-2. It was assumed that the hand movements in Records 1 to 4 could not interfere with the impulse movements of the voice, since any hand movements in Records 1 to 4 were unintentional and unconscious. It is evident from Tables S-1 and S-2 that active tapping does not interfere with the normal time-pattern of impulse movement in a thinking-speaking process. As an example of the graphic representation of measurements in Table S-1, Graphs S-7 and S-8 are included. The consistency of patterns between Records 1 to 4 and Records 5 to 8, and 9 and 10 for each individual is clear. There is no evidence of a basic change in the pattern when active tapping is used during speaking. The similarity of patterns in these two graphs for the two individuals is characteristic of all graphs made for the ten subjects in Table S-1. The graphs for *Selection B* are nothing like those for *Selection A*, but are uniquely similar to each other for the different individuals. This similarity suggests that each unique bit of literature has a unique pattern of impulse movement.

TABLE M-10

LENGTH OF IMPULSE UNITS IN MM. SELECTION *A* SUBJECT SM

NO. OF RECORD	1	2	3	4	5	6	7	8	9	10	Av.	M.D.	R*
Preparation	28	50	53	47	45	55	48	30	38	58	45.2		
So	31	43	40	39	32	27	31	34	23	35	33.5	4.7	
weeks	40	53	35	30	24	25	29	22	22	27	30.7	7.1	32.1
grew	13	19	15	16	20	11	21	11	10	14	15.0	3.2	
months	68	72	51	70	62	66	84	88	58	63	68.2	8.2	40.8
years	72	118	75	112	107	108	99	108	90	104	99.3	12.3	99.3
gleam	38	21	47	48	40	36	36	37	38	35	37.6	4.6	
by	15	15	23	18	15	20	16	18	12	11	16.3	2.7	
gleam	28	33	32	24	32	33	22	30	26	15	27.6	4.6	27.1
the	7	9	10	8	8	9	14	12	12	6	9.5	1.9	
glo-	15	11	12	13	13	8	10	9	10	6	10.7	2.1	
ry	19	25	14	15	19	24	27	17	8	13	17.3	4.7	
dropped	17	19	17	26	23	22	24	24	24	24	22.0	2.6	14.9
from	17	18	18	18	15	16	18	23	12	19	17.4	2.0	
their	17	14	14	15	10	15	15	16	15	11	14.2	1.6	
youth	34	37	25	40	35	23	43	32	16	26	31.1	6.9	20.9
and	13	9	15	17	12	12	17	13	13	13	13.4	1.7	
love	78	74	71	88	88	78	82	71	83	73	78.6	5.3	46.0
and	21	21	23	16	19	22	22	22	13	17	19.6	2.6	
both	18	22	16	16	19	21	22	19	13	18	18.4	2.2	
per-	11	11	6	9	13	10	16	14	12	10	11.2	2.0	
ceived	60	36	38	92	32	59	52	27	20	26	43.8	17.0	23.2
they	6	7	9	22	10	25	19	10	13	10	13.1	5.3	
had	12	18	15	19	13	12	12	14	11	15	14.1	2.1	
dreamed	31	53	52	40	59	58	33	35	38	31	43.0	9.7	
a	11	11	10	15	9	12	17	18	14	15	13.2	2.6	
dream	75	91	91	85	67	53	58	70	80	89	75.9	11.3	31.9

*R is the average length per impulse unit for the grouping indicated.

TABLE N-10

LENGTH OF IMPULSE UNITS IN MM. SELECTION *B* SUBJECT SM

NO. OF RECORD	1	2	3	4	5	6	7	8	9	10	Av.	M.D.	R*
Preparation	8	x	48	x	17	30	32	x	47	41	35.9		
Hence	70	97	55	84	102	76	103	112	62	79	84.4	15.6	84.4
hor-	15	14	14	14	12	18	13	12	20	19	15.2	2.4	
ri-	10	11	9	9	9	9	12	10	8	13	10.0	...	
ble	25	20	26	22	8	16	13	18	18	29	19.5	4.9	
shad-	15	16	13	10	9	18	15	13	12	21	14.2	2.8	
ow	39	71	74	90	95	71	58	77	61	60	69.6	12.1	25.7
un-	38	16	35	29	15	21	36	28	28	26	27.2	6.2	
real	45	35	31	27	27	22	27	48	24	34	32.0	6.8	29.6
mock-	15	18	18	20	18	13	25	18	13	20	17.8	2.5	
er-	8	12	12	12	15	14	11	11	10	9	11.4	1.6	
y	36	35	45	58	46	44	36	59	41	15	41.5	7.9	23.6
hence	90	104	98	80	68	85	95	120	112	76	92.8	13.0	92.8

*R is the average length per impulse unit for the grouping indicated.

TABLE S-1

AVERAGE PER SYLLABLE FOR SELECTION *A*.

(A) RECORDS 1 TO 4, (B) RECORDS 5 TO 8, (C) RECORDS 9 AND 10.

SUBJECT	Fr			Di			Re			Sa			St			Ha			Mc			Gr			Pa			Sm		
RECORDS	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
So	33	41	38	27	29	35	34	32	40	27	27	25	28	30	35	45	31	35	30	31	28	26	25	31	46	44	43	41	31	29
weeks	32	33	33	50	38	43	33	36	28	37	39	32	36	42	37	36	31	39	49	46	44	39	38	42	38	41	32	39	25	24
grew	24	18	17	18	15	20	17	16	14	20	18	18	21	18	16	16	15	13	22	21	23	19	17	21	18	19	16	16	16	12
months	60	57	63	48	48	47	67	63	50	53	64	47	67	38	47	52	44	54	68	64	64	61	63	80	65	50	47	65	75	60
years	73	72	64	81	57	61	93	67	67	80	89	79	75	56	63	77	66	71	96	86	91	72	80	86	64	67	67	94	105	97
gleam	32	33	32	53	32	38	32	30	28	30	33	36	46	32	38	41	32	37	49	44	46	48	42	60	58	50	51	38	37	36
by	22	19	19	21	19	14	23	20	21	22	22	21	24	20	21	21	17	14	17	15	14	17	15	14	23	17	18	18	17	11
gleam	34	28	28	41	38	32	59	51	36	27	45	31	32	29	26	44	31	37	45	58	42	27	36	36	49	47	46	29	29	20
the	11	12	10	10	12	10	11	14	13	10	11	10	9	8	10	14	14	10	14	18	8	10	10	12	16	15	17	9	11	9
glo-	10	10	9	8	10	10	12	15	13	8	7	8	10	13	8	14	12	12	13	13	12	14	13	12	17	9	19	13	10	8
ry	24	20	23	23	30	24	26	24	14	21	17	18	20	14	19	14	14	13	17	18	15	14	15	16	15	24	17	18	22	10
dropped	27	25	26	24	34	21	43	44	30	29	27	28	30	19	18	20	18	17	23	28	26	22	31	29	23	21	18	20	23	24
from	14	14	14	20	28	28	14	18	25	12	14	16	14	14	14	21	17	17	16	17	17	15	12	12	14	14	20	18	18	15
their	14	14	13	19	15	17	15	13	13	12	11	12	14	12	10	13	11	11	19	16	12	17	15	14	14	16	14	15	14	13
youth	28	27	22	33	24	25	61	45	44	16	15	14	38	17	15	16	17	21	22	27	29	27	29	29	16	21	20	34	33	21
and	15	14	13	12	11	13	13	14	15	13	13	11	15	12	10	12	12	10	11	13	12	15	13	15	15	15	12	16	13	13
love	62	54	53	59	48	57	78	67	52	58	66	63	71	47	54	56	58	58	62	50	53	68	61	65	46	39	36	78	79	78
and	24	25	16	27	22	15	13	19	39	24	20	22	31	32	32	31	23	16	30	28	31	21	21	29	28	24	29	20	21	15
both	24	23	24	29	29	25	26	28	27	24	26	29	27	20	22	21	20	23	26	27	26	19	25	25	29	25	25	18	20	15
per-	11	14	12	12	14	17	14	17	11	15	14	9	15	9	12	15	15	14	14	16	15	15	12	16	17	13	21	9	13	11
ceived	44	44	35	43	52	42	61	54	46	33	42	37	50	26	24	51	40	51	59	50	53	34	39	38	40	44	40	54	42	23
they	10	11	9	14	21	20	8	10	15	9	11	9	35	10	10	34	10	14	19	20	22	9	15	9	15	19	14	11	16	11
had	18	16	18	19	15	17	14	17	11	21	19	21	30	13	13	15	16	16	20	18	22	10	18	22	25	20	24	16	13	13
dreamed	34	30	27	54	38	42	71	51	29	32	33	30	58	23	35	59	46	44	41	38	41	39	34	35	46	41	49	44	46	34
a	14	14	16	13	12	14	11	17	15	14	13	12	21	10	10	17	14	22	10	13	10	12	11	12	17	18	14	12	14	14
dream	85	69	86	83	72	117	67	63	76	76	75	90	88	69	89	77	81	84	53	71	65	82	85	98	63	78	72	85	62	84

TABLE S-2

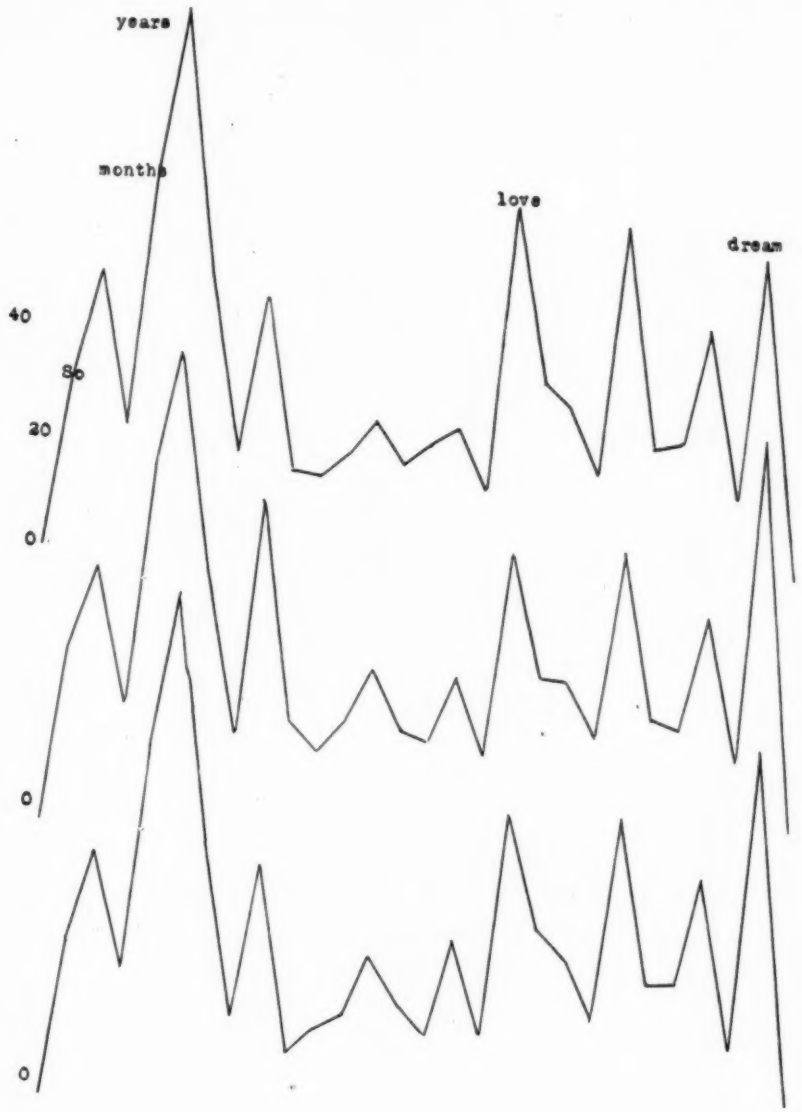
AVERAGE PER SYLLABLE FOR SELECTION *B*.

(A) IS THE AVERAGE OF RECORDS 1 TO 4, (B) RECORDS 5 TO 8, (C) RECORDS 9 AND 10.

SUBJECT	FR			SM			DI			RE			SA			ST			HA			MC			GR			PA		
RECORDS	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Hence	80	68	102	79	98	70	80	66	102	63	78	72	53	50	58	78	78	88	71	64	58	66	62	42	78	84	100	64	59	76
hor-	21	18	20	14	14	19	21	18	20	16	23	15	10	13	15	19	29	16	20	14	14	18	22	15	17	15	31	19	19	21
ri-	9	11	13	10	10	10	9	11	13	11	13	14	12	15	12	11	9	8	8	7	8	7	8	9	10	13	9	15	16	14
ble	20	24	21	23	14	23	20	24	22	17	18	13	18	16	13	16	14	17	13	12	11	11	11	10	16	17	23	28	21	20
shad-	19	17	17	13	16	16	19	17	17	15	22	20	14	12	15	18	16	12	19	14	16	20	17	18	22	22	20	13	15	17
ow	51	56	66	68	74	60	51	56	66	52	52	39	17	36	28	50	42	48	28	28	32	50	52	51	43	40	42	34	28	33
un-	17	19	19	29	24	27	17	19	19	17	21	21	18	18	22	28	40	35	30	19	21	30	30	27	34	37	36	20	20	27
real	36	36	33	34	31	29	38	36	33	38	42	34	23	28	30	30	47	37	24	21	23	32	35	27	29	28	39	27	30	37
mock-	17	15	13	18	18	16	18	15	13	14	30	12	18	16	15	15	18	16	16	12	12	14	18	12	24	19	22	19	18	12
er-	11	12	15	11	12	9	11	12	15	11	15	8	8	12	10	9	10	8	8	6	8	10	10	14	9	9	9	12	14	13
y	39	48	45	43	46	28	39	48	45	40	32	41	28	25	21	42	38	37	17	18	15	38	38	33	32	37	40	22	20	27
hence	123	86	78	93	94	94	122	86	78	108	82	89	72	79	85	88	107	106	96	90	109	89	88	112	108	100	127	110	96	94

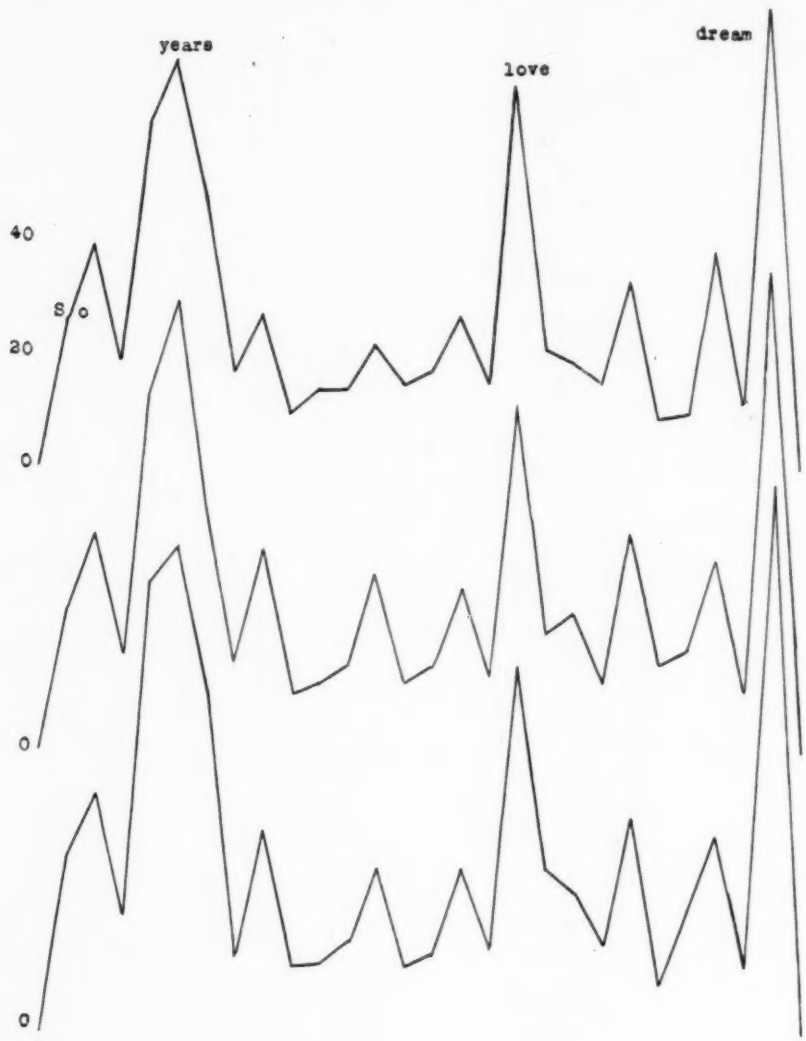
GRAPH S-7

SHOWING THE RELATIVE TIME PER SYLLABLE FOR SELECTION A, SUBJECT MC. TOP CURVE IS THE AVERAGE FOR RECORDS 1 TO 4. MIDDLE CURVE IS THE AVERAGE FOR RECORDS 5 TO 8. BOTTOM CURVE IS THE AVERAGE FOR RECORDS 9 AND 10.



GRAPH S-8

SHOWING THE RELATIVE TIME PER SYLLABLE FOR SELECTION A, SUBJECT GR. TOP CURVE IS THE AVERAGE FOR RECORDS 1 TO 4. MIDDLE CURVE IS THE AVERAGE FOR RECORDS 5 TO 8. BOTTOM CURVE IS THE AVERAGE FOR RECORDS 9 AND 10.



1. *Comparison of the total time of the various records* is given in Table M-11. Total time tells nothing of the internal patterns of movement, but if the total time in Records 1–4 is very much less or greater than the total time in Records 5–8, or 9 and 10, then this would be evidence that active tapping changes the normal speed of the thinking-speaking process. Table M-11 shows no such evidence.

2. *Comparison of the difference between the duration of successive units for Records 4 and 5, Selection A* was made to test more closely any possible tendency of active tapping to weaken or destroy

TABLE M-11

SUM TOTAL TIME IN MM. FOR EACH SUBJECT IN RECORDS 1 TO 10, SELECTION *A*.

SUBJECT / RECORD	FR	DI	RE	SA	ST
1	786	925	958	720	864
2	824	970	1006	750	896
2	792	731	912	712	1140
4	730	769	801	736	780
Av.	780	849	919	729	920*
5	729	824	935	755	660
6	810	781	947	752	556
7	736	706	719	790	706
8	678	798	766	795	634
Av.	738	777—	841	778	639†
9	697	803	817	757	719
10	734	819	728	717	669
Av.	715	811	772	732	694‡

SUBJECT / RECORD	HA	MC	GR	PA	SM
1	878	879	817	975	767
2	859	824	751	709	860
3	894	879	719	811	774
4	714	826	730	782	911
Av.	836	852	754	819	828*
5	658	911	702	811	796
6	695	887	711	783	805
7	753	765	894	810	839
8	755	850	804	768	794
Av.	715	853	849	793	808†
9	771	810	850	796	696
10	744	841	867	781	720
Av.	757	825	858	788	708‡

* The average of records 1 to 4.
† The average of records 5 to 8.
‡ The average of records 9 and 10.

the variety in the pattern of impulse movement. The difference in time-length between each unit and the one that followed it in Record 4 was compared with the same difference in Record 5. It was assumed that variety would be indicated by this change in length from one unit to the next, and that if the changes in length in Record 5 should be substantially and consistently less than in Record 4, this would be evidence that active tapping lessened the variety assumed to be normal in Record 4. The measurements in Table M-12 show no such evidence. In this table, columns 4v and 5v were obtained by subtracting each unit in a record from the unit that followed. For example, *so* in Record 4, Subject Fr., is 26 mm. long and *weeks* is 28 mm. long. The change in length from *so* to *weeks* is therefore 2 mm. Columns D1,

TABLE M-12

DIFFERENCE IN LENGTH BETWEEN SUCCESSIVE UNITS IN RECORDS 4 AND 5, SELECTION *A*.

SUBJECT		FR			DI			RE	
RECORD	4v	5v	D1	4v	5v	D2	4v	5v	D3
So	x	x	x	x	x	x	x	x	x
weeks	2	0	—2	21	16	—5	11	14	3
grew	7	7	0	28	24	—4	15	22	7
months	41	34	—7	26	36	10	41	58	17
years	7	22	15	30	28	—2	15	9	—6
gleam	36	49	13	24	40	16	37	52	15
by	11	22	1	25	22	—3	9	7	—2
gleam	12	9	—3	16	28	12	36	42	6
the	23	15	—8	28	36	8	47	50	3
glo-	1	0	—1	5	1	—4	2	5	3
ry	19	8	—11	18	21	3	11	11	0
dropped	2	2	0	5	20	15	2	44	42
from	16	9	—7	2	22	20	10	52	42
their	0	2	2	15	18	13	3	2	—1
youth	13	11	—2	15	25	10	55	30	—25
and	12	11	—1	24	17	—7	52	28	—24
love	49	42	—7	47	25	—22	55	61	6
and	44	45	1	34	22	—12	55	57	2
both	6	1	—5	8	6	—2	12	19	7
per-	15	6	—9	17	14	—3	8	14	6
ceived	31	7	—24	29	49	20	38	48	10
they	31	10	—21	31	39	8	45	62	17
had	7	4	—3	4	11	7	4	8	4
dreamed	16	12	—4	32	30	—2	50	63	13
a	17	17	0	35	32	—3	52	68	16
dream	56	59	3	61	55	—6	58	64	6
Sum	474	394		570	637		723	890	
Total time of record	730	729		769	824		801	935	
*Index	.649	.540		.741	.773		.903	.952	

* The index is obtained by dividing the sum of the variations for the record by the total length of the record as taken from Table M-11.

TABLE M-12 (Continued)

SUBJECT		Sa			St			Ha	
RECORD	4v	5v	D4	4v	5v	D5	4v	5v	D6
So	x	x	x	x	x	x	x	x	x
weeks	13	5	—8	19	19	0	20	1	—19
grew	20	17	—3	24	21	—3	8	12	4
months	32	66	34	20	19	—1	13	27	14
years	21	17	—4	29	28	—1	28	14	—14
gleam	36	74	38	39	28	—11	27	26	—1
by	17	5	—12	5	9	4	15	14	—1
gleam	27	9	—18	6	7	1	12	7	—5
the	37	21	—16	21	28	7	20	7	—13
glo-	4	3	—1	2	10	8	2	4	2
ry	15	11	—4	10	5	—5	2	4	2
dropped	6	13	7	3	8	5	1	1	0
from	15	19	4	8	6	—2	5	1	—4
their	1	1	0	1	3	2	9	8	—1
youth	3	4	1	38	8	—30	1	10	9
and	3	8	5	38	11	—27	0	7	7
love	37	74	37	44	46	2	36	27	—9
and	24	69	45	30	22	—8	20	27	7
both	3	13	10	1	5	4	11	15	4
per-	4	12	8	15	20	5	1	2	1
ceived	9	23	14	30	24	—6	26	16	—10
they	19	28	9	28	21	—7	2	25	23
had	11	13	2	16	7	—9	30	6	—24
dreamed	11	10	—1	8	7	—1	44	30	—14
a	14	18	4	12	14	2	41	32	—9
dream	62	63	1	95	39	—56	58	40	—18
Sum	444	596		538	415		432	363	
Total time of record	736	755		780	660		714	658	
Index	.603	.789		.689	.629		.605	.552	

TABLE M-12 (Continued)

Subject		Mc			Gr			Pa	
Record	4v	5v	D7	4v	5v	D8	4v	5v	D9
So	x	x	x	x	x	x	x	x	x
weeks	1	31	30	14	17	3	24	23	—1
grew	16	38	22	16	15	—1	21	28	7
months	58	44	—14	41	42	1	60	33	—27
years	4	29	25	3	14	11	14	0	—14
gleam	24	52	28	11	34	23	5	5	0
by	37	29	—8	38	17	—21	34	28	—6
gleam	38	65	27	12	13	1	28	21	—7
the	25	60	35	16	21	5	31	23	—8
glo-	13	7	—6	0	1	1	3	3	0
ry	5	5	0	2	3	1	6	19	13
dropped	10	7	—3	16	16	0	8	8	0
from	6	7	1	12	18	4	11	3	—8
their	3	0	—3	9	11	2	9	0	—9
youth	4	6	2	10	0	—10	3	0	—3
and	1	12	11	19	7	—12	2	2	0
love	45	40	—5	49	37	—12	20	23	3
and	30	19	11	43	41	—2	2	15	13
both	3	1	—2	0	11	11	3	3	0
per-	8	18	10	7	11	4	18	8	—10
ceived	31	37	6	19	29	10	29	30	1
they	34	37	3	20	29	9	32	29	—3
had	7	7	0	3	3	0	14	12	—2
dreamed	14	20	6	24	12	—12	18	22	4
a	26	26	0	27	13	14	19	29	10
dream	38	43	5	74	68	—6	47	64	17
Sum	481	640		485	483		461	431	
Total time of record	826	911		730	702		782	811	
Index	.582	.703		.666	.688		.589	.531	

TABLE M-12 (Continued)

Subject Record	4v	Sm 5v	D10	(+D) — (—D)
So	x	x	x	x
weeks	9	8	—1	0
grew	14	4	—10	19
months	54	42	—12	16
years	52	45	—7	—7
gleam	64	67	3	124
by	30	25	—5	—53
gleam	6	17	11	25
the	16	24	8	21
glo-	5	5	0	5
ry	2	6	4	3
dropped	11	4	—7	59
from	8	8	0	50
their	3	5	2	7
youth	25	25	0	—23
and	23	23	0	—48
love	71	76	5	—2
and	72	69	—3	32
both	0	0	0	27
per-	7	6	—1	11
ceived	83	19	—64	—43
they	70	22	—48	—10
had	3	3	0	—25
dreamed	21	46	25	14
a	25	50	25	31
dream	70	58	—12	—66
Sum	744	657		167
Total time of record	911	796		
Index	.817	.825		

D2, etc., were obtained by subtracting the numbers in column 4v from those in 5v. Column marked (+D) — (—D) gives the sum of the plus numbers in columns D1, D2, etc., less the sum of the minus numbers. The sum of this column is plus 167. This means that variability as a whole was slightly greater in Record 5 than in Record 4. In Table M-12, the sum of column 4v and 5v is given in each case together with the total time. By dividing this sum by the total time, an index of variability is obtained. In six cases out of ten, this index is higher for Record 5 than for Record 4. This indicates that Record 5 has slightly greater variety than Record 4.

D. Relation Between the Intensity of Hand Impulse and the Duration of the Impulse Unit.

The intensity of the hand impulse is indicated in the records by the height of the curve for each stroke. In Table H-1 and Graph H-2, these heights are compared with the lengths of corresponding impulse

TABLE H-1

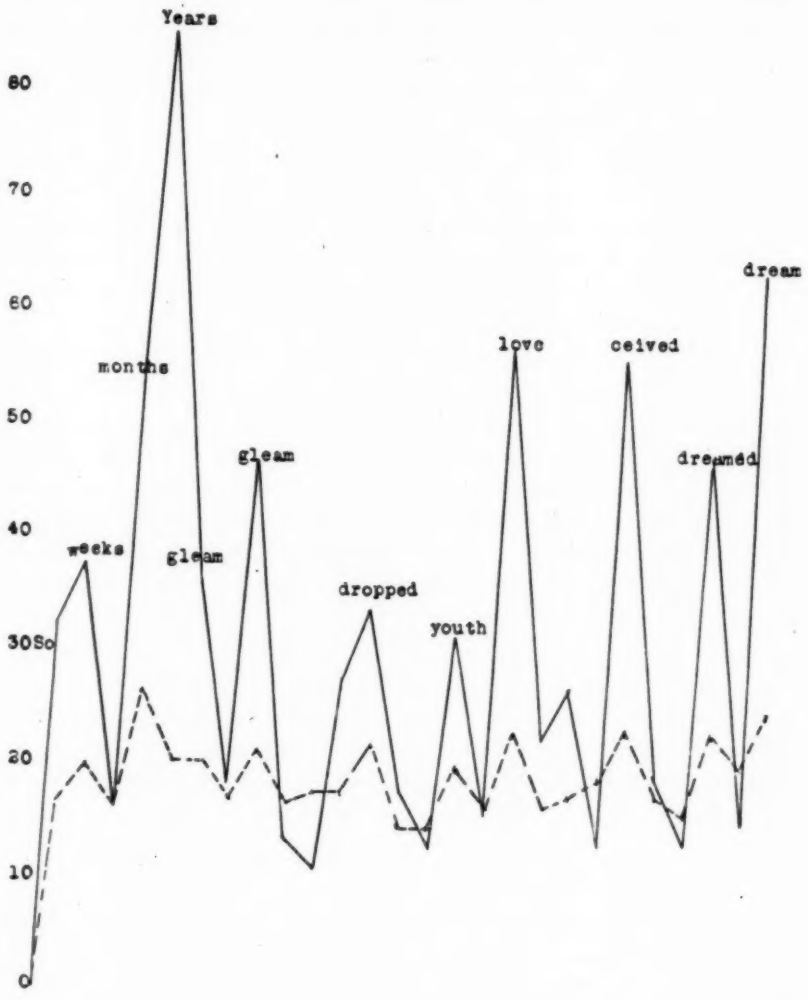
MAXIMUM HEIGHT IN MM. OF THE HAND TAPPING CURVE FOR EACH UNIT IN SELECTION *A*, RECORD 6, SUBJECTS DI, RE, HA, PA, AND SM.

SUBJECT	DI	RE	HA	PA	SM	AVERAGE HEIGHT	*AVERAGE LENGTH
So	18	15	22	13	15	16.6	31.6
weeks	28	16	26	15	13	19.6	37.8
grew	23	11	21	13	12	16.0	16.6
months	31	20	27	18	16	26.0	53.8
years	26	16	27	15	16	20.0	79.2
gleam	27	20	25	15	13	20.0	36.0
by	17	16	17	18	14	16.4	18.8
gleam	30	22	20	20	13	21.0	46.2
the	20	x	20	13	11	16.0	13.4
glo-	21	15	23	16	14	17.8	10.8
ry	22	12	23	16	16	17.8	27.4
dropped	33	15	29	19	13	21.8	33.2
from	15	11	25	13	8	14,4	17.8
their	14	15	27	9	6	14.2	12.8
youth	24	17	26	20	12	19.8	31.0
and	19	18	21	17	9	16.8	15.6
love	31	20	25	24	13	22.6	56.8
and	15	16	19	19	11	16.0	22.2
both	15	14	20	24	12	17.0	26.6
per-	20	23	19	21	11	18.8	13.0
ceived	21	20	22	27	13	22.6	55.2
they	21	13	21	20	10	17.0	18.8
had	x	16	23	15	8	15.5	15.6
dreamed	27	29	23	22	12	22.6	47.0
a	20	25	22	21	11	19.8	15.0
dream	34	33	23	20	12	24.4	63.4

* The average length is the length for Record 6 for the five subjects as found in Tables M-1 to M-10.

GRAPH H-2

COMPARISON OF THE AVERAGE LENGTH OF UNITS WITH THE AVERAGE INTENSITY OF THE HAND TAP FOR SELECTION A, RECORD 6, SUBJECTS DI, RE, HA, PA, AND SM. THE DOTTED LINE IS THE INTENSITY CURVE.



units. This sample from the records of *Selection A* gives general evidence that intensity and duration of impulse go together. An apparent exception is seen in Graph H-2, where the intensity curve for *years* goes down while the duration curve goes up. Introspectively, *years* is more intense in meaning than *months*. It probably gets its intensity more through increased duration than increased motor energy. Within limits, duration and intensity are psychologically interchangeable. Then, too, energy sustained in time means greater energy. Energy is measured by combined time and intensity.

E. Relation Between the Duration of the Hit-and-Hold of the Hand and the Duration of Tone, Breath Pressure, and Syllabic Phonation.

A hit-and-hold behavior of the hand on certain syllabic impulses is clearly seen in the records as illustrated in Plates 1 and 7. Tapping that goes with thinking is not merely a hitting-rebounding process, like touching a hot stove, but is a hitting-and-hanging-on process. All records from 5 to 8 in which this hit-and-hold behavior was reasonably complete and clear enough for accurate measurement were measured; 22 records for *Selection A*, 19 for *Selection B*. Table HS-4 is a sample of these measurements. In this table, the column marked T is the total duration of the syllabic unit, H the duration of the hit-and-hold of the hand, B the duration of the breath pressure, V the duration of the tone, S the duration of the total syllabic sound production, and HSD is H minus S. One would expect the measurements in column S to be greater than those in column V, because the tone plus the toneless part of a syllable is longer than the tone alone. One expects the numbers in column H to be less than those in column T, because the hit-and-hold of the hand does not include the time in which the hand is raised from the recording tambour, a period that is part of the total duration of the impulse. One expects the breath active in phonation to be longer than the tone, and equal to, or longer than, the total syllabic sound. The measurements as illustrated in Table HS-4 verify these expectations. From this table it is evident that the tenacity of the hand impulse action and the tenacity of the speech impulse action as a whole are very nearly the same. The difference between the sum of H and the sum of S is very small. H minus S is more often minus than plus. Theoretically this is as it should be, because H is only the time of the hit-and-hold and not of the total hand action. In Plate 1 the total hand action is seen to be a continuous process with no dead moments or stopping in the hand movement.

TABLE HS-4

RELATION BETWEEN THE DURATION OF THE HIT-AND-HOLD OF THE HAND AND THE DURATION OF THE BREATH, TONE, AND SPEECH WITHIN CERTAIN IMPULSE UNITS.

SUBJECT RECORD	T	H	SA 8A B	V	S	HSD	T	H	HA 8A B	V	S	HSD
weeks	48	18	40	18	37	—19	32	16	32	12	32	—16
months	62	62	62	15	50	12	47	55	47	21	47	8
years	91	65	90	45	65	0	71	74	60	37	60	14
gleam	42	21	42	35	38	—17	31	16	29	22	29	—13
gleam	33	22	33	22	33	—11	17	21	17	17	17	4
dropped	27	21	22	18	22	—1	20	22	15	10	15	7
youth	15	5	15	12	15	—10	14	13	14	14	14	—1
love	64	52	64	22	40	12	55	x	45	29	(45)	x
-ceived	37	30	37	22	37	—7	47	51	43	22	43	8
dreamed	39	30	39	34	35	—5	50	25	50	42	48	—23
dream	75	55	61	49	61	—6	111	100	111	40	65	35
Sum	533	381	505	292	433	—52	495	393	463	266	370	23

SUBJECT RECORD	T	H	MC 8A B	V	S	HSD	T	H	GR 8A B	V	S	HSD
weeks	39	6	39	21	39	—33	36	25	36	17	33	—8
months	77	50	70	30	70	—20	72	58	60	30	60	—2
years	74	72	60	20	50	22	83	73	75	32	68	5
gleam	46	20	40	30	35	—15	51	22	51	34	51	—29
gleam	59	55	55	40	55	0	32	21	32	27	32	—11
dropped	21	8	21	9	21	—13	37	27	30	13	18	9
youth	26	6	26	20	26	—20	33	24	33	22	30	—6
love	52	46	47	31	36	10	57	54	50	37	40	14
-ceived	46	46	35	14	30	16	42	47	42	32	42	5
dreamed	35	7	35	35	35	—28	33	29	33	33	33	—4
dream	84	84	65	32	35	49	72	70	72	65	70	0
Sum	559	400	493	282	432	—32	548	450	514	342	477	—27

SUBJECT RECORD	T	H	PA 8A B	V	S	HSD	T	H	SM 8A B	V	S	HSD
weeks	33	16	33	15	33	—17	33	23	33	18	33	—10
months	45	36	45	21	40	—4	88	72	85	30	80	—8
years	60	50	56	42	52	—2	108	72	90	44	70	2
gleam	50	52	50	34	38	14	37	21	37	34	34	—13
gleam	45	37	40	33	40	—3	30	18	30	30	30	—12
dropped	21	14	14	8	14	0	24	6	20	10	20	—14
youth	15	10	15	10	15	—5	32	6	32	12	27	—21
love	38	38	35	27	30	8	71	64	71	23	50	14
-ceived	33	32	28	22	28	4	27	20	27	20	27	—7
dreamed	40	26	40	33	38	—12	35	10	35	35	35	—25
dream	84	80	60	40	60	20	70	30	63	50	55	—25
Sum	464	391	416	285	388	3	555	342	523	306	461	—119

Table HS-8 gives the summary of H-S for *Selection A*. The difference between the sum of the plus and minus values for each impulse is interesting. Where the thought seems most completely finished, the difference approximates zero or becomes plus, as on *years, dropped, love,* etc. Where the thought is most in suspense the difference is minus, as on *weeks, gleam, dreamed,* etc. The holding behavior of the hand comes where there is momentary completeness and satisfaction in the meaning; where a succession of syllabic impulses reaches its integration in the total action of a thinking impulse.

The evidence on the relation between the duration of the hit-and-hold of the hand and the duration of the tone, breath pressure,

TABLE HS-8

SUMMARY OF H MINUS S AS TAKEN FROM TABLES HS-1 TO HS-4. SELECTION *A*.

RECORDS	IMPULSE UNITS.*											
	WE.	MO.	YE.	GL.	GL.	DR.	YO.	LO.	CE.	DR.	DM.	SUM
RE5A	—25	—15	—6	—8	5	23	—13	13	15	12	—1	0
HA5A	0	12	0	—2	0	—7	—6	2	0	x	x	—1
MC5A	—39	—44	—4	—33	—2	—2	—14	12	—2	—25	10	—143
PA5A	—21	—22	—15	—6	—10	0	0	—2	6	—14	—12	—72
SM5A	—11	0	20	—5	—3	4	0	38	—3	3	25	67
FR6A	0	—7	—16	3	—9	—4	4	8	4	—17	—14	—48
HA6A	—11	0	11	—19	—17	—3	—5	2	14	—6	25	—9
MC6A	—30	6	—14	—13	—12	—14	—24	5	—2	—38	40	—96
PA6A	—20	—16	—2	—20	1	1	—8	8	—3	—8	30	—37
GR6A	—11	—13	—5	—5	—2	5	—3	7	0	0	20	—7
FR7A	—12	—7	—12	—17	—2	—16	x	—9	—12	—12	15	—84
SA7A	—24	3	0	—18	—5	3	—10	13	—2	—4	0	—44
HA7A	—4	—2	8	0	3	7	5	28	3	4	32	84
GR7A	—16	—6	—10	—17	—2	5	—4	11	17	—6	25	—3
PA7A	—12	—3	—12	—28	—18	—8	—5	3	—4	—6	—17	—110
SM7A	—9	—1	10	—16	—4	—13	—12	22	—2	—9	—3	—37
SA8A	—19	12	0	—17	—11	—1	—10	12	—7	—5	—6	—52
HA8A	—16	8	14	—13	4	7	—1	x	8	—23	35	23
MC8A	—33	—20	22	—15	0	—13	—20	10	16	—28	49	—32
GR8A	—8	—2	5	—29	—11	9	—6	14	5	—4	0	—27
PA8A	—17	—4	—2	—14	—3	0	—5	8	4	—12	20	3
SM8A	—10	—8	2	—13	—12	—14	—21	14	—7	—25	—25	—119
No. of +	0	5	8	2	4	9	2	19	10	3	13	
No. of —	20	15	11	19	16	11	17	2	10	17	6	
No. of 0	2	2	2	1	2	2	2	0	2	1	2	
Sum of +	0	41	92	17	13	64	9	230	92	19	326	
Sum of —	348	170	98	308	121	95	167	11	44	242	77	
Difference	—348	—129	—6	—291	—108	—31	—158	219	48	—223	249	

* *We.* stands for weeks, *mo.* for months, *ye.* for years, etc.

and syllabic phonation adds to the other evidence that a record of the movements of the hand in active tapping during speaking is essentially the same record of impulse movement as the record taken at the same time from the voice and breathing.

VII. Summary

The main evidence in this study may be summarized as follows:

1. One stroke of the hand for each syllable is the normal behavior in tapping during speaking. The normal tendency is to tap syllables, not measured beats or phrasal surges. Hand tapping and articulatory tapping spontaneously go together. Untrained and undirected subjects had an average of 93.2% of taps with syllables for *Selection A* and 84.1% for *Selection B*.

2. The moment-of-hit of the hand and voice come together. The average variation from simultaneity between the hit of the hand and the beginning of the voice tone was .02 seconds.

3. There is no evidence from the records that active tapping weakens or tends to destroy the patterns of impulse movements made when tapping is not used. Tapping does not tend to make the speaking mechanical or monotonous.

4. The hit-and-hold behavior of the hand corresponds in duration to that of the total syllabic production. The hand record is a more complete record of the duration and intensity of impulse units than that of the tone or the breath pressure. It is a more definite and less complex record of the changing energies and duration of both motor and thinking impulse movements in a thinking-speaking process than is a record taken from the voice.

5. Intensity in the hand impulse matches closely that of the thinking-speaking impulse, as far as these intensities in the thinking-speaking impulses may be inferred from the duration of impulse units, from the phrasal groups, and from introspective analysis. The certainty of a hand stroke with a syllable increases with the duration of the syllable, and also with the articulatory certainty of the syllable in speaking. If *they had* becomes *they'd*, one stroke is used instead of two. If *glory* becomes *glo'y*, one stroke tends to be used.

6. Passive and unconscious pressure responses in the hand tend to harmonize in time and intensity with the phrasal surges in speaking.

VIII. Conclusion

The findings in this study seem to indicate clearly that impulse movements in the hand in active tapping during a thinking-speaking

process are a part of the same psychological process as impulse movements in the voice, and that adequate records of these impulse movements in the hand can be used by themselves as scientific records for the study of impulse movements in a thinking-speaking process. By these hand records patterns of impulse movements in large bodies of literature or in longer speeches can be studied. Tests of time and intensity variation in speaking, and studies in speaking habits, rhythm, and style can be made. Such records of hand movements can be made during either silent or spoken language. They can be made and studied with relative ease, at low cost, and in large quantities. Records as long as a roll of paper can be made without interruption. Possible studies by the use of such records are many.

DIAPHRAGMATIC ACTION OF GOOD AND POOR SPEAKING VOICES

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University of Denver

THE purpose of this study is to ascertain and compare the action of the diaphragm in good and poor voices during speech. Since speech is vocalized breath, and since there seems to be so much variance of opinion concerning types of breathing, a careful study of one of the factors in breathing may give an academic basis for unanimity of opinion.

The only study known to have isolated the problem of diaphragmatic action in speech and singing was made with the fluoroscope by Schilling in Germany in 1922.[1] The greater part of the work related to the singing voice. Observations were made of the right hemidiaphragm while the subject counted. The most important contributions of the study may be summarized as follows:

1. In the majority of cases the excursions of the diaphragm during counting were almost like those in quiet breathing.

2. In starting phonic expiration the other organs of breathing initiate activity one and one-half seconds before the diaphragm.

3. The diaphragm and the other organs of respiration are synchronated in inspiration but are asynchronous in expiration.

The report of the study does not indicate the number of subjects used, an actual measurement of diaphragmatic excursion, or a discrimination between good and poor voices.

Part of two studies by Bloomer[2] comment favorably upon the feasibility of studying the diaphragm during speech by means of the fluoroscope.

In the medical field the Roentgen rays have been used extensively for study of the diaphragm under pathological conditions. A number

[1] Schilling, R., "Movements of the Diaphragm in Speaking and Singing," *Deutsche Medizinische Wochenschrift*, 58, November 17, 1922, 1551–1552.

[2] Bloomer, Henry Harlan, "A Method of Determination of the Diaphragmatic Factor in Respiration," unpublished Thesis, University of Michigan, April, 1935. Bloomer, Henry Harlan, "A Roentgenographic Study of the Mechanics of Respiration," SPEECH MONOGRAPHS, 2, 1936, 117–124.

of studies similar to those of Butler and Dana,[3] Martin,[4] O'Brien,[5] and Starling[6] have been made to determine the amount of excursion during normal breathing. The average excursion during quiet breathing is agreed to be between 1.25 cm. and 1.50 cm. During forced breathing, excursion ranges from 6.5 cm. to 7.5 cm. These studies are particularly significant in comparing the amount of excursion during the phonation with the amount of excursion without phonation.

Two recent investigations have made valuable contributions to the general problem of breathing with some specific point to this study. Bloomer[7] has evolved a formula for calculating the approximate volume of pulmonary exchange for which the diaphragm is responsible. His bibliography and introduction contain a valuable survey of the physiological approach to breathing. Wiksell[8] has summarized comprehensively reasearch and points of view particularly in the field of speech. He concluded that no type of breathing is distinctly superior to any other in securing maximum volume of breath movement after studying some twenty-five subjects with the pneumograph and spirometer. He also indicated that, if a subject is proficient in getting a very good average excursion through the use of no particular type of breathing, he will find it of no advantage—and it may be a disadvantage—to develop the use of a controlled thoracic inflation. The individual will be even less successful with the abdominal type of respiration. On the basis of the measurements of thoracic and abdominal expansion, the study leads him to conclude further that individuals were able to use thoracic control to an advantage when they desired, but that it was practically impossible to obtain abdominal control.

[3] Butler, Paul F., and Dana, Harold W., "Diaphragmatic Excursions, Normal and Pathologic," *American Journal of Medical Sciences*, 176, October, 1928, 569–577.

[4] Martin, Charles L., "Roentgen Rays Studies of the Diaphragm," *Southern Medical Journal*, 18, March, 1925; 170–177.

[5] O'Brien, Frederick W., "Elevation of Diaphragm," *Radiology*, 10, March, 1928, 186–233.

[6] Starling, Ernest H., *Principles of Human Physiology*, Second Edition, Philadelphia: Lea & Febiger, 1915, 899–959.

[7] Bloomer, Henry Harlan, "A Method of Determination of the Diaphragmatic Factor in Respiration," unpublished Thesis, University of Michigan, April, 1935.

[8] Wiksell, Wesley A., "An Experimental Study of Controlled and Uncontrolled Types of Breathing," an unpublished Thesis, University of Louisiana, 1935.

The investigation which this paper is reporting used twenty poor voices and twenty good voices. The voices were selected by instructors in the department of speech at the University of Denver and include men and women of varying ages and professions. Ages in both groups varied from sixteen to fifty years. An attempt was made to select the extremes in both types of voice.

Each person spoke the first stanza of "Mary Had a Little Lamb"; this was thought to be free from emotional connotations. Each person spoke the verse three times—first, in his normal speaking voice, second, in a voice that would fill a large auditorium, and third, in a vocalized stage whisper.

The data upon which the conclusions are based was obtained from a fluoroscopic study of the diaphragm in action. Each subject was placed 36 centimeters from the target of the x-ray tube and behind the fluoroscopic screen at an average screen-target distance of 55 centimeters. Preliminary studies were made at greater distance. The difference of diaphragmatic excursion resulting from distortion of the shadow upon the fluoroscopic screen was so slight that it fell below the limits of accuracy of measurement.

The observer watched normal breathing and established as a base line, drawn tranversely across the screen, that position in the vertical plane of the subject at which the excursion of the right dome of the hemi-diaphragm above the line was equal to the excursion below the line. During the vocalization of the prescribed verse, maximum and minimum excursions of the highest part of the right dome were traced on the glass front of the screen by the orthodiagraphic method. A different colored pencil was used for each type of speaking to avoid errors. Most subjects were checked at least twice. After the orthodiagraphic recording the room was lighted to assure an accurate measurement of excursion on the actual glass front of the fluoroscope.

Patients who seemed a little emotionally unstable or somewhat excited by the test soon became normal when led into conversation by pleasantries. When attention was directed away from their breathing and speaking, the excursions of the diaphragm were shorter and more steady than upon arrival in the fluoroscopic room.

Three questions seem pertinent in the discussion of the findings of this research. Is there any signficant difference between the manner of movement of the diaphragm in good voices and in poor voices? Are there significant differences in diaphragmatic excursion

during whispering, loud, and normal vocalization regardless of whether the voice is good or poor? Are there significant differences of diaphragmatic excursions between good and poor voices?

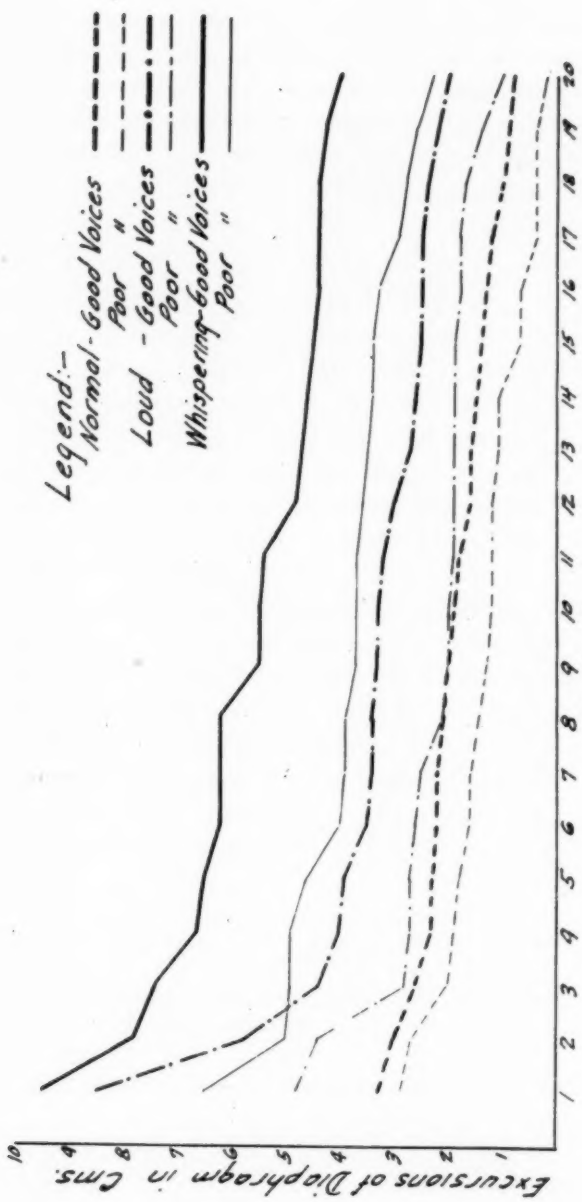
Compare and contrast the movement of the diaphragm in both types of voices. In all cases but one the diaphragm moves steadily up and down in good speaking voices. In eighteen out of twenty poor voices the action is jerky and irregular. The exceptions in the latter group suggest the presence of other factors in development of a good voice. In agreement with Schilling, observation showed that the diaphragm almost stops with the onset of vocalization and then starts slowly again. The longer the individual talks within certain limits the higher the diaphragm goes. One interesting case of a poor voice with unusual diaphragmatic action should be mentioned. Although the movement of the diaphragm was steady, it descended far below the normal base line before the first word of the speech and never again came above the line during vocalization. During normal and loud vocalization by this individual the centimeters of excursion of this case were less than the 1.25 cm. average excursion for the individual during quiet breathing without vocalization. These considerations should be of importance because they cannot be recognized by the use of such research instruments as the pneumograph and spirometer. They suggest that something more than a peripheral examination is necessary if the conclusions of Wiksell and others are to be justified; from these observations diaphragmatic action may be seen to have more importance.

To answer the second problem, a matter of determining differences in excursion of normal, loud, and whispered speech, study graph 1. Notice that the centimeters of excursion fall into three distinct zones varying from 0.2 cm. to 9.5 cm. The excursion during normal vocalization falls consistently below that during loud vocalization. The latter is consistently below that of the whispering quality. The extreme excursion of the good voice is that of a former professional actor. This point is further emphasized by a comparison

CHART I

COMPARISON OF MEANS AND MEDIAN DIAPHRAGMATIC EXCURSION OF GOOD AND POOR VOICES DURING THREE TYPES OF VOCALIZATION

	NORMAL		LOUD		WHISPERING	
	MEAN	MEDIAN	MEAN	MEDIAN	MEAN	MEDIAN
Good Voices	1.65 cm.	1.85 cm.	3.45 cm.	3.1 cm.	5.69 cm.	5.45 cm.
Poor Voices	1.29 cm.	1.20 cm.	2.29 cm.	1.95 cm.	3.85 cm.	3.70 cm.



Graphs Showing Diaphragmatic Excursions in Good & Poor Speaking Voices

GRAPH I

of the means and medians for normal, loud, and whispering voices. Considering the average of excursion during the quiet breathing without vocalization, it is significant that the normal speaking probably has little if any more diaphragmatic excursion than unphonated breathing. For the loud group the ratio considering means would be as 1.25:3.45 and for the poor voices 1.25:2.29. The difference is further intensified in whispering where the ratio would stand in good voices 1.25:5.69 and in poor voices 1.25:3.83. A comparison of the average normal excursion with that of the loud and whispering in both groups makes this idea of three zones of excursions strikingly evident. In good voices the mean excursion is twice as great as the normal, and the whispering is almost three and a half times as great as the normal. With the poor voices the mean of the loud group is 75% greater than the normal and the whisper almost three times greater. This simply means that loud speaking requires greater use of the diaphragm than the normal voice, and that whispering requires greater use than either of the other two.

Further study of the first graph suggests probably the most important consideration of this investigation—the actual difference in centimeters in the diaphragmatic excursion between good and poor voices. In each of the three types of vocalization the line representing the poor voices is consistently below the line representing good voices. For the normal the mean excursion of the good voices is 28% more than the poor. The mean excursion for the loud is 51% greater for good voices than for poor, and for whispering voices the mean for good voices is 40% greater than the poor.

CHART II

COMPARISON OF THE MEANS OF EXCURSION SHOWING THE PER CENT OF INCREASE FOR GOOD VOICES

Normal	1.65 cm.	1.33 cm.	29%
Loud	3.45 cm.	2.29 cm.	51%
Whispering	5.69 cm.	3.80 cm.	48%

This may suggest that flexibility in diaphragmatic action is an important factor in vocal flexibility. The foregoing data and that which follows makes it even more evident that there may be an advantage in terms of centimeters of diaphragmatic excursion in good voices which measurement by pneumograph does not indicate.

The polygons of frequency—graphs 2, 3, and 4—illustrate how the largest number of poor voices tend to group around a point indicating less diaphragmatic excursion than a similar grouping of good voices. This is not so much in evidence in graph 2 because the differences in centimeters are not so great in normal speaking as in the other two groups. Even here, however, 30% of the poor voices fall below the lowest of the good. The narrowness at the bottom of the polygon emphasizes the facts that good voices have 2% greater deviation from the median than poor and that a maximum excursion of the good is 14% greater than the poor. In graphs 3 and 4, loud and whispering vocalization, the difference in excursion between good and poor voices is unquestionable. In the loud 50% of the poor voices are below the lowest of the good; the deviations of the good voices from the average are 101% greater than the poor, and the maximum excursion for the good is 74% greater than the poor. Briefly for the whispering group, 70% of the poor voices fall below the lowest of the good; good voices have 42% greater deviations from the average than the poor, and the maximum excursion of the good is 46% greater than that of the poor.

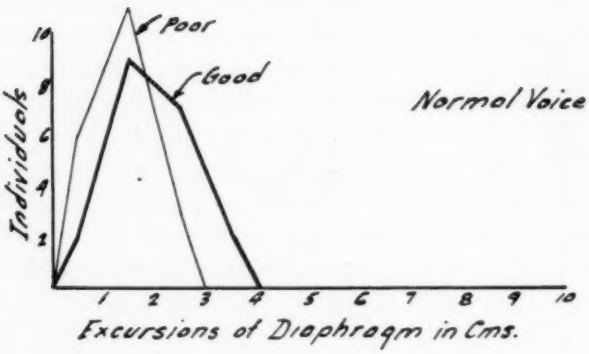
A third approach of this same problem is through comparison of quartiles.

CHART III

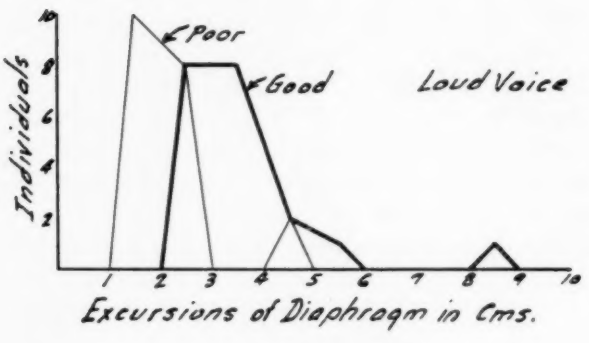
COMPARISON OF DIAPHRAGMATIC EXCURSIONS IN GOOD AND POOR VOICES IN TERMS OF QUARTILES

	Normal		Loud		Whispering	
	Good	Poor	Good	Poor	Good	Poor
Q_1	1.35 cm.	0.7 cm.	2.5 cm.	1.85 cm.	4.45 cm.	3.35 cm.
Q_2	1.85 cm.	1.2 cm.	3.1 cm.	1.95 cm.	5.45 cm.	3.7 cm
Q_3	2.25 cm.	1.7 cm.	3.7 cm.	2.65 cm.	6.35 cm.	4.3 cm.

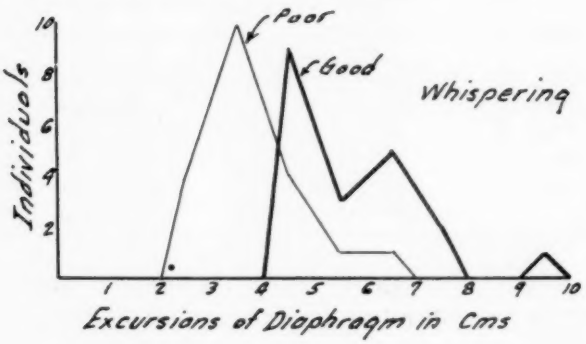
These facts are significant. The second quartile for the poor voice in the normal and loud groups fall below the first quartile of the good voices. In the whispering group the poor voices of the third quartile are below the first quartile of the good voices. Only two poor voices of the normal are above the third quartile of the good; only two poor voices of the loud and one of the whispering are above the second quartile of the good in their respective groups. In other words there is a marked difference between good and poor voices in the amount of diaphragmatic excursion. This difference is more marked in loud and whispered vocalization than in normal.



GRAPH II



GRAPH III



GRAPH IV

Graphs Showing Frequency of Diaphragmatic Excursions in Good & Poor Speaking Voices

Summary and Conclusions

Diaphragmatic excursions of the right hemi-diaphragm of twenty individuals with good voices and twenty individuals with poor voices were studied and recorded during fluoroscopic examination. Each individual spoke the same material three times—with normal vocalization, with loud vocalization, and with vocalized stage whisper. Comparisons and contrast of the data suggest the following conclusions:

1. Action of the diaphragm in good voices tends to be steady and in poor voices jerky. This was a matter of subjective observation.

2. The average centimeters of excursion for normal speaking closely approximate the average excursion during quiet breathing without phonation. Loud and whispered speech show greater excursion than the average excursion without phonation.

3. Whether the voice be good or poor, greater diaphragmatic excursion is always required by the loud voice than the normal, by the whispering than the loud.

4. In all three types of vocalization, the good voice shows greater diaphragmatic excursion than the poor. This is more marked in the loud and whispering group than in the normal.

5. Contrary to conclusions of certain late studies on the subject, this research indicates an important relationship between good voices and the amount and kind of diaphragmatic excursion.

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THE CARDIAC CYCLE AS A PHYSIOLOGICAL DETERMINANT OF ENERGY DISTRIBUTIONS IN SPEECH*

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THIS investigation is an outgrowth from a suggestion made by Professor J. H. Muyskens of the University of Michigan in 1931 [1] that a speech curve is very similar to the Traube-Hering wave in circulation. "Far be it from me to suggest a coincidence, but I have felt for some time that speech must be correlated with these vegetative functions." The investigation concerns itself with energy distributions in speech, and the effect of one of these vegetative functions, that of the circulatory rhythms, upon the energy distributions.

Prior to the experimentation reported by Professor Muyskens in "The Hypha"[2] little objective work had been done on accent. Since that time incidental work has been done by Shohara,[3] Steer and Tiffin,[4] E. Ray Skinner,[5] and others, but with the exception of Shohara, these investigations are open to criticism from the objective point of view. Shohara realized the necessity for a correlation between the vegetative rhythms and accent—*i.e.,* large energy distributions. "The problem of accent must also be considered in relationship to the alimentary acts . . . an even rhythmicity, that is,

* A condensation of a dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Science in the University of Michigan under the following graduate committee: Professors C. L. Meader, J. H. Muyskens, H. H. Shohara, Leon H. Strong, N. E. Nelson.

[1] Muyskens, J. H., "The Smallest Aggregate of Speech Movement Analyzed and Defined. The Hypha," Doct. Diss. Univ. of Mich., Part I, Accent; pub. Vox, 17 Jahrgang, Heft 2, Mai, 1931.

[2] *Ibid.*

[3] Shohara, Hide, "A Contribution to the Genesis of the Articulatory Movements of Speech, with Special Reference to the Processes of Chewing, Sucking, and Swallowing," Doct. Diss. Univ. of Mich., abstract pub., *Quarterly Journal of Speech,* 21, June, 1935.

[4] Steer, Max D., and Tiffin, Joseph, "A Photographic Analysis of the Use of Intensity by Superior Speakers," *Studies in Phonetics and Phonology,* 1, September, 1934.

[5] Skinner, E. Ray, "A Calibrated Recording . . . etc.," SPEECH MONOGRAPHS, 2, October, 1935.

evenness of energy output and periodicity in the wave of contraction are charactertistic of the peristaltic activity of smooth muscle . . . also characteristic of the stages of the swallowing process . . . Variation in energy does occur here as a result of the resistance to progress offered by the condition of the bolus. Thus accent in language has its archetype in swallowing."

Reasoning from the physiological processes of anabolism and katabolism, Shohara[6] in 1934 reached the conclusion that "this alternation in the extent of energy output is a fundamental characteristic of all life processes, including speech, and is a physiological basis of rhythm. In the English language, these strong energy outputs, marked by loudly pronounced accents, succeed one another at a rate of about one per minute."[7]

Early in the investigation, before objective work was commenced, the investigator was struck independently by the same conclusion. It seemed that these loudly pronounced accents occurred regularly near the ventricular systole of the radial pulse. Listening to various speakers seemed to confirm this suspicion. It should be made clear that these stresses, or accents, or large energy quanta in speech are not necessarily the result of the so-called pronunciation stress, but occur as a result of fundamental meaning content. These large energy quanta may fall on conventionally accented hyphae, or they may not. The strictly conventional pronunciation stress is limited in its appearance to other bio-linguistic laws with which this investigation is not concerned.

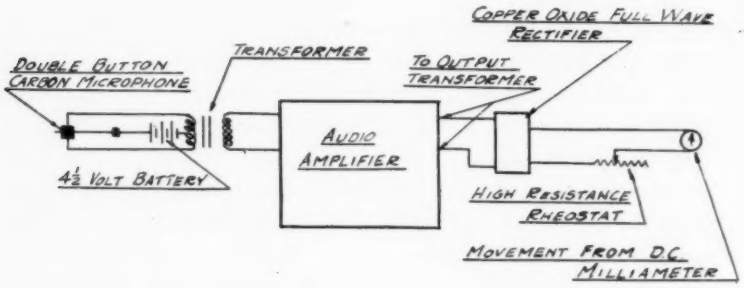
Whether there are physiological determinants or regulators of this play of energy distribution upon the specific details of the speech continuity forms the essential cause for the appearance of this investigation. Due to the large amount of muscle, nerve, and glandular tissue involved, any determination of the place of this energy distribution in the scale of functions must lead inevitably to a closer understanding of cellular organization and integration.

[6] Shohara, Hide, "Some Biological Factors Involved in Coptic Sound Changes. App. to Coptic Sound Change," Worrell, W. H., Univ. of Mich. Humanistic Series, Vol. XXVI.

[7] The actual rhythm of these large accents in the data compiled here was 129.78 per minute, which brings the rhythm closer to the United States Army step. The ear must miss then approximately ⅓ of these accents. The ear may register differing energy complexes in an entirely different manner, or the meaning content may confuse the ear. The problem cannot now be settled.

Apparatus, Subjects, Types of Speech Recorded

The objective study was commenced with the equipment used by Muyskens for "The Hypha," with the addition of a Gsell sphygmomanometer. Upon analysis of the records, it was seen that too many factors which were uncontrollable had entered the results. Hysteresis and other physical errors of the apparatus, and the dis-



comfort of the subjects rendered any results questionable. Muyskens had already suggested in the Hypha several means of obtaining energic measurements, but all of them were cumbersome for a large scale undertaking, and none of them were free from inertia and momentum errors. Professor J. M. Schmidt of Hillsboro College suggested that since the frequencies in an electrical hook-up travel along the wire as alternating frequencies a full wave copper oxide rectifier connected to a DC milliameter would give the result desired.

The amplograph[8] consists of a two button carbon microphone

[8] See diagram.

connected to a transformer and an audio-amplifier. From the amplifier the alternating frequencies are led to the rectifier, which changes the alternating current to a direct current fluctuating in amperage as the waves build up and down in amplitude and complexity. This increase and decrease is not gradual, but sudden, since the energy builds up by the square of the frequency complexes times the amplitude.[9] The rectifier is connected to a milliameter, the glass face of which was removed, a brass bar added to the back and placed in a right angle clamp attached to a pivoting metal support whose vertical position can also be adjusted by means of a thumb screw and spirit level.[10] A dog's hair was drawn through rubber cement and attached to the stylus of the recorder, and was found very satisfactory, being light and limber, yet stiff enough to record well on the smoked kymograph record. The milliameter recorder has a hair spring adjustment so that when the recorder is turned on its side to record on the kymograph, the weight of the hair and stylus can be compensated.

Since the stylus does not have to travel back and forth with each double vibration, the usual inertia and momentum errors are mechanically eliminated, and the remainder were largely checked in the analysis by counting the absolute onset of the sudden increase in energy and ignoring the overshoot of the stylus at the bottom of its swing.[11]

The respiratory rhythms were measured by the Lombard apparatus, and the radial pulse was taken by means of a Lombard radial pulse apparatus, and the radial pulse curve was recorded synchronously with the amplographic curves. The records were timed with an electro-magnetic timer operating at $\frac{1}{5}$ second. Extreme care was used to prevent motor and gear vibration by means of additional felting and loose pulley belts waxed with beeswax. No vibration was observable in the records.

The subjects were all adults of no known cardiac pathology as ascertained in routine physical examinations by the family physician. The age range was 20–40, with a mean of 26. 42 were female, 21

[9] See diagram of amplograph curve.

[10] Experimental support, Eberbach.

[11] In any further experimentation along these lines, the possibility of recording on film with the cathode ray should not be overlooked. A quantitative measurement could be obtained. The cathode ray recorder should be so arranged that the light beam would travel vertically; the film could be gradated as in decibel apparatus, and analysis should be comparatively easy.

male.[12] Seven were stutterers;[13] 5 were male, 2 female, with a mean age of 21.5.

45 records were made of normals reading aloud selections taken at random from newspapers and magazines. After the records had been fixed, the selection read was pasted to the back of the record. 5 records were of normals responding to questions asked by the operator. 3 records were of normals repeating the nonsense syllable "pa." 3 records were of normals repeating again and again the series: "pa, ko, ta, pe, tar, ki, ne, ba, ra, sa, da." 6 records were of stutterers reading aloud. One record was made of a stutterer responding to questions.[14]

The subjects were told an experimental record on speech was being run, and given the material. No further instructions were given, since subjects do not have to be instructed in the use of this type of apparatus.

Analysis of the Records; Collection of Data

The customary techniques for analysis of kymograph records were followed, making corrections for alinement, distortion, etc.[15] The phasic points measured were the points of onset of large and sudden changes in the amplograph line, and the points of onset of the primary wave of the radial pulse.[16]

The percentages of time which elapsed between the onset of the primary wave and the onset of a large change in the amplograph line were calculated, giving the proportion of the pulse beat which had elapsed before the accent occurred. This was necessary since the pulse rates varied between 1.4 and 6.4 fifths seconds, and a common basis of comparison was necessary to establish statistical significance, and determine the cardiac relationships. A separate tabulation was made for each pulse rate. Calculations were carried to the second place. The total number of accents occurring on each pulse rate was divided by the number of perentage integers at that pulse rate. Thus,

[12] No note is taken in this investigation of sex differences.

[13] Stuttering being a "disorder of verbal rhythm."

[14] The records were of differing lengths, and the content cannot be judged by the number of records.

[15] Lombard, Warren P., *Laboratory Work in Physiology*, 3d ed., George Wahr, 1920, pp. 276–284.

[16] The dicrotic notch was discarded, due to inaccuracy in relationship to the heart.

a pulse rate of 3.0 had a total of 437 accents. The chance dispersal should have located 14.57 accents on each possible percentage point.

Next to avoid the unfair comparisons presented by the multiplication table, this chance dispersal total was collected and totaled for each percentage point. This gave the expectation by chance for the occurrence of large energy quanta from 00 to 98%. Since the computation was carried to the second place only, a cross total was made with an error resulting of .02 on each percentage point. Since this could not affect any result the error was allowed to stand.

Synthesis of the Data, and Gross Results

The accumulated material was next examined by the Bernoulli formula. The total accents falling on each percentage point were compared with the chance dispersal expectation, and a table drawn showing the results. The formula $\delta = \sqrt{npq}$ was applied[17] where n equalled the number of accents involved,[18] p the chance dispersal total divided by n, and q equalled n minus the chance dispersal total divided by n. The formula applies equally well for units, continuous, or broken groups, when the chance expectation is known. It was applied first to units, then continuous groups, and finally disconnected groups with central tendencies.

In the examination of the 5953 instances of energy distribution in relationship to the pulse curve, it became clear that some portions of the curve are favorable to the development of large energy quanta, some are unfavorable, and other portions seemed indifferent. The latter may be the result of too few cases. All of the phenomena are of interest since all may lead to knowledge of a fundamental nature concerning the physiological determinants of intensive action.

It will save confusion to discuss first those areas of the pulse curve favorable to the distribution of accent. The onset of the primary wave of the radial pulse is the point where the largest total of accents occurred. It was at first assumed to be a result of the muliplication table, but the formula showed a t of 7.32.

[17] The formula gives the value of the probable distribution by chance of the same type of items during a certain operation. 3 sigma (t equals 3.00) is assumed to be outside the probability of chance. While 2.50 is generally assumed to be certain, only 3.00 was accepted as final here. See Burgess, Robert W., *Introduction to the Mathematics of Statistics,* Houghton, Mifflin, 1927.

[18] n is not the same on each percentage point, owing to the multiplication table, and this had to be calculated.

The members of the group 31–35% of the pulse curve inclusive were nearly all favorable, but were below the limits of certainty. When the two most favorable points in this group are examined together t equals 2.92, which is so close to certainty that they were held for special examination when the data was examined for types of speech and speakers.

The next group, 51–65% inclusive has a t of 4.11. Only one of the members, 64%, was large enough to have occurred outside of chance. Thus a process of elimination was carried out, testing all the possible combinations of members in this group. The final significant group was 51,54,55% with a t of 3.50. It was assumed that the favorability to accent develops rather suddenly here, and centers in this group. A second grouping was also discovered of 60–64% inclusive which was significant with a t of 3.08.

Considering next those portions of the radial pulse curve where significantly fewer accents fell, the first group encountered is 2–6% inclusive. The group has a t of only 2.78. When the point 5% is eliminated a t of 3.08 is achieved, and it may be accepted that the points 2,3,4,6% are unfavorable to the development of accent.

The group 39–49% inclusive has a t of 2.87 but was discarded for lack of confirmation in the more detailed examination later.

The final portion of the pulse curve (66–98% inclusive) develops some problems, because the second largest deviation from sigma (97%) occurs here, and overbalances all of this group. The group 95–98% inclusive has a t of 6.13. When 97 and 98% are removed from the group, the results are no longer significant. However a fall in significance occurs between 88–90% inclusive, and it was suspected that there might be a group between 66–87% inclusive. This group has a t of 1.46. However, when the members of the group which are not in accord with the central tendency are eliminated, the group is significant. These members that were dropped had no statistical significance in any combination, and must have fallen by chance caused by too few cases. The group centers in 72, 83, 86%.

Analysis of the Data Involving Different Types of Speech and Speakers

The instances of accent studied were distributed in the following manner: Normals—Reading Aloud—3368 cases; Conversing with Operator—324 cases; Nonsense syllable "pa"—1042 cases; Nonsense

syllable series—241 cases; Sutterers—Reading Aloud: 631 cases; Conversing—150 cases. Total: 5756 cases.[19]

The procedure was the same as for the general analysis, followed by the application of the Bernoulli formula for units, continuous, and disconnected groups.[20] Due to the limitations of space it will not be possible to describe this process in detail. Confirmation was found in each type of speech of the groups and units already discussed. The stutterers, however, varied from the normal, and the results should be discussed.

a. Stutterers Reading Aloud

The group 13–19% is favorable to accent with a t of 2.50. Elimination raises the certainty to only 2.87. However, this result is partially confirmed in the Conversing group, and further experimentation might develop a statistically reliable group.

The group 44–72% inclusive is favorable to accent with a t of 3.94.

The group 20–43% inclusive is unfavorable to the production of large energy quanta with a t of 2.71. Elimination shows a group of 20,22,23,24,25,26,27,29,30,32,34,35,37,39,40,41,43% with a t of 3.64.

The group 72–79% can only be raised to a t of 2.71. However it is interesting to note that this group parallels the normal distribution, and might conceivably become significant with further study.

b. Stutterers Conversing With the Operator

The group 2–19% inclusive is favorable to accent when elimination has been carried out. The eliminated units are not significant.

It must be remembered that further study might develop other significant groups than the ones mentioned in this study. Thus a complete curve may not have been reached. The results attained, however, justify certain conclusions.

The Portions of the Heart Beat Affecting the Distribution of Energy

There was, in general, close agreement between the findings for the total experiment, and the various types of speech with normal

[19] Two records of normal subjects reading aloud were inadvertently omitted from the analysis. 197 cases were involved.

[20] This rather arduous method of arriving at a common ground seemed to have no substitute, since examining each pulse beat and its accentual accompaniment on physiological grounds would not only have been inaccurate and illogical, but even more awkward.

speakers, the subjects saying "pa" forming two small extra groups favorable to accent 39–49% inclusive, and 88–90% inclusive, the explanation for which must be left to further investigation. This could have occurred as the result of cardiac changes in these subjects, or perhaps, the repetition of the monosyllables lies closer to the primitive speech pattern, and thus is more sensitive to changes in the heart beat. It will be seen that both of these groups follow closely upon significant changes in the cardiac cycle. In opening a new field of investigation many questions arise which cannot be answered with the data at hand. In one or two instances groups and units appearing in the total distribution did not occur in the partial distribution. The Bernoulli formula was applied, and showed that the absence of cases was responsible rather than any change in the phenomena.

The normal material will be examined first.

The portions of the radial pulse curve favorable to the development of large energy quanta are: 00%; 31,33%; 51–65% inc. The portions unfavorable are: 2,3,4,6%; 66–81% inclusive; 95–98% inclusive.

It is next necessary to see what the radial pulse represents in relation to the heart.

"The pulse in the arteries may be defined as a wave of pressure which is transmitted through the elastic vessels, and produces in their successive portions an expansion, an elongation, or both."[21] Mechanico-pneumatic systems of recording these pressure changes utilize this expansion wave in order to achieve a relative measure of what is happening in the heart. In ventricular systole, a volume of blood is forced into the aorta, which becomes distended. This sudden distention sends an expansion wave down the arteries which gradually grows smaller, meanwhile altering some of its characteristics until it reaches the capillaries, where no sign of the pulse is left. When ventricular systole closes, the semilunar valves occlude and there is a sudden diminution of pressure in the aorta, followed by a slight increase. Thus the radial pulse consists of a primary or systolic wave, followed by a dicrotic notch, which represents roughly the close of systole.

Lewis[22] remarks that the interval between the arterial upstroke

[21] Wiggers, Carl J., *The Pressure Pulses in the Cardiovascular System.* Longmans, Green and Co., 1928, p. 67.

[22] Lewis, Thomas (Sir), *The Mechanism and Graphic Representation of the Heart Beat.* 3d Edition. Paul B. Hoeber, 1925, p. 23.

and the dicrotic notch is a very inexact measurement of systole in the arteries, and of course, in the heart. He continues, however, by saying that the interval between one upstroke and another (the primary wave) is almost, if not quite as exact as curves taken with far more delicate apparatus. Thus the radial pulse gives a quite exact measurement of the duration of the cardiac cycle, although it is indirect and bears no relationship to blood flow, volume, or velocity

In drawing inferences concerning the cardiac cycle from the radial pulse it is necessary to bear in mind the fact that the expansion wave occupies time in traveling from the aorta to the radial artery. Lamson[23] estimates this time at .10 second. Lewis[24] is perhaps more accurate in estimating it at .13 second, since he includes the .03 second delay caused by recording the carotid artery. If Lewis is correct, the point 00% does not occur on left ventricular systole but .13 second later. Wiggers[25] says that the velocity of the pulse is increased when the blood pressure is high or the arterial walls are tense. All subjects were assumed to be normal, but as will be seen later, this possibility may have entered the results.

The mean pulse time of the total experiment was 3.52 fifths of a second. Since most physiologies give cardiac measurements in decimals this is a rate of .704 second, or 85.23 beats per minute.[26]

Each percentage point of the data, then, represents an elapsed time of .00704 second. Consequently left ventricular systole would commence approximately half-way between 81 and 82% of the data. Since a significant group closes here, the discussion of the cardiac cycle will be commenced from this point, although since the advent of electro-cardiography, auricular systole is conventionally chosen to initiate the cardiac cycle, due to the fact that the P or auricular wave initiates the action currents of the cycle.

The various general physiologies give only vague information on the duration of ventricular systole. At 72 beats per minute Halliburton and McDowall assume ventricular systole to continue about .30 second. At a rate of 63 per minute Lewis assumes it to continue about .38 second. At 70 per minute Howell assumes it to be .379 second. He quotes an experiment by Einthoven on a normal man

[23] Lamson, Paul Dudley, *The Heart Rhythms*, Baltimore: Williams and Wilkins Co., 1921, p. 21.

[24] *Ibid.*, p. 24.

[25] Wiggers, Carl J., *ibid.*, p. 75.

[26] This rather rapid rate is at least partially explained by the fact that the subjects were speaking during the experiment.

whose ventricular systole varied between .312 and .346 second in a series of fifteen heart beats.[27] The rate of the beat in this experiment is not given.[28] Wiggers[29] is the only physiologist to present data of a more or less exact nature on the duration of ventricular systole at varying rates of the heart.

The theoretical average of ventricular systole at rate 85 per minute is .25 second according to Wiggers.[29] At a rate of 85.23 this would give a duration of .248 second. A portion of ventricular systole is devoted to the isometric contraction phase.[30] Thus the measurement of 81.5% as the commencement of ventricular systole is actually that of effective ventricular systole, referred to by Wiggers as the ejection phase. The isometric contraction phase is that time in ventricular systole when the bicuspid and semilunar valves are closed, and is characterized by a steady rise in pressure until the semilunar valves are forced open by the increase in pressure.[31] The time for this event has been estimated by Willius at .07 to .09 second, by Wiggers[32] at .05 second at a rate of 75 per minute. At 85.23, this time would be .0459 second,[33] leaving the phase of effective ejection at .2021 second. This brings the end of ventricular systole to the point of the pulse 10.2%.

This period of ejection from the left ventricle may be divided into two phases, the period of maximum ejection, and the period of reduced ejection.[34] At 85.23 beats per minute, the time of maximum ejection would be .0827 seconds. This would concern the percentage points 81.5–93.25% of the radial pulse curve. The time of reduced

[27] Halliburton and McDowall, *A Handbook of Physiology*, 34th ed., P. Blakiston's Sons and Co., 1935, p. 127; Lewis, Sir Thomas, *The Mechanism, etc.*, . . .; Howell, Wm. H., *A Text Book of Physiology*, W. B. Saunders and Co., 1934, 12th ed., p. 579.

[28] The reasons for this paucity of information are that ventricular systole can vary within limits without being pathological, and the generally assumed hypothesis that the principle change in the cardiac cycle at varying rates is in diastole.

[29] Wiggers, Carl J., *Physiology in Health and Disease*, Philadelphia: Lea and Febiger Co., 1934, p. 587.

[30] Wiggers, Carl J., *Pressure Pulses, etc.*

[31] Willius, Fredrick, *Clinical Electrocardiography*, W. B. Saunders, 1932, p. 21.

[32] Wiggers, Carl J., *ibid.*

[33] Assuming that the isometric phase reduces proportionately with ventricular systole, and that Wiggers is correct.

[34] Wiggers will be followed for the remainder of the discussion.

ejection would be .1194 second, or from the percentage points 93.25–10.25%. (That is, considering the point 00% as intermediary and going on through the cycle.)

The events of ventricular diastole are divided functionally into the phases of proto-diastole, isometric relaxation, rapid inflow, diastasis, and auricular systole. The proto-diastolic phase is devoted to bringing into apposition the semilunar valves which have already floated toward closure. At a rate of 85.23 per minute this phase occupies .0338 second, estimating that auricular systole is smaller in the same proportion as ventricular systole. The proto-diastolic phase would occupy the percentage points 10.2–15.0% inclusive.

In the isometric relaxation phase, the heart is relatively quiescent. At 85.23 per minute, it would occupy .0676 second. This would include the percentage points 15.0–24.61%.

There follows the period of rapid inflow, or as Lewis calls it, active diastole. At 85.23 per minute the percentage points included would be 24.61–37.82% inclusive.

Diastasis, or the passive phase of the heart occupies .1006 second, and the percentage points 37.82–60.63% inclusive.

Auricular systole occupies .101 second, and the percentage points 60.63–74.97% inclusive.

The isometric contraction phase occupies .0459 second and includes the percentage points 74.97–81.5 inclusive.

When the phenomena of the experiment are compared with the events of the cardiac cycle, it is interesting to note that there is an observable lag in the appearance of energy distributions of about .03 second. Each group is shifted to the right, (*i.e.*, farther along in the cardiac cycle) approximately .03 second, and if this shift had not occurred, all of the significant groupings would have tallied closely with significant changes in the functioning of the cardiac cycle.

There are several possible explanations, but with the data at hand it is impossible to come to a conclusion:

1. There may have been a constant error in the marking of radial systole in the records. The scratch, in the effort to mark the absolute onset of the upstroke, may have been set a fraction of a millimeter to the left.[35]

[35] One mm. in these records represented about .101 second. The estimates should be correct to between .01 and .02 second, for any given measurement, and for a large series the mean of the error should be within the third decimal. (Verified by experiment.)

2. There may have been an error in assuming the arterial delay to be .13 second. That there is a range of error here is demonstrated by Wiggers.[36] "My own observations confirm the conclusion that the pulse velocities encountered in patients with hypertension certainly fall within the ranges found yearly in young, healthy medical students." According to Wiggers, the pulse velocities reported by various investigators range at age 26 from 4.8 to 8.4 metres per second. The variation is explained by the fact that the exact distance traversed from the aorta to the radial artery in any given individual can only be estimated.

3. There might possibly be a physiological lag from the occurrence in the cardiac cycle to the muscular structures involved in the production of large energy quanta. If Wiggers is correct in his statement that the speed of nervous propagation along these paths is 30–90 metres per second,[37] and if it is assumed that a metre is the distance traveled from the heart to the brain to the speech musculature, this would occasion a delay of about .03 second, estimating at the slowest speed of propagation of nervous impulse.[38]

Which of these assumptions may be the closest to the truth is a matter of hazard. A combination of these and other factors may be involved. Regardless of what may later prove to be the truth, it must be accepted that the events of the cardiac cycle, as described, play important roles in the determination of energy distributions in speech. All such favorable and unfavorable points must be regarded as having occurred through the determining factors of the cardiac cycle, and *it may be stated as a law that the events of the cardiac cycle are physiological determinants of energy distributions in speech.*

The stutterers, however, show variations from the normal picture. The pulse rate is essentially the same[39] (3.519 normals, 3.524 stutterers), and since this has already been analyzed for its relationship to the cardiac cycle, it will be sufficient to note the phases of the cycle at which the energy distributions were affected.

The theoretical lag for stutterers seems to be .04 second instead

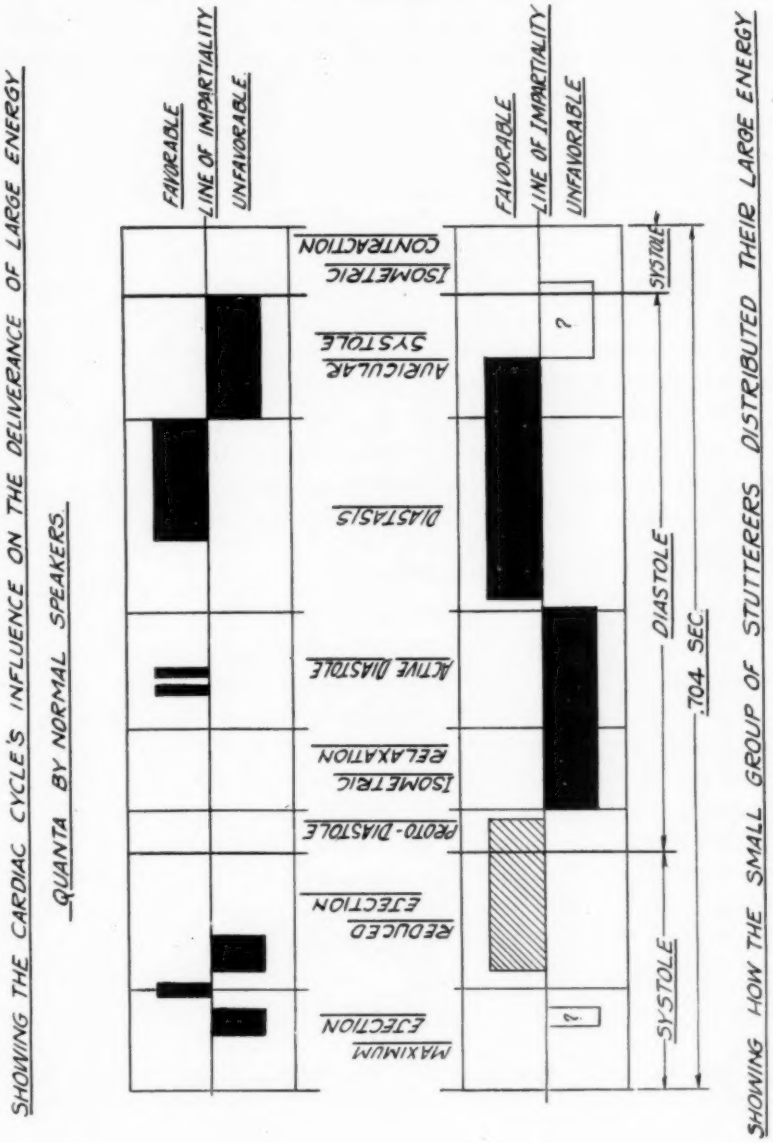
[36] Wiggers, Carl J., "Physical and Physiological Aspects of Hypertension, *Ann. Int. Med.*, Vol. 6, 1932, p. 14.

[37] Wiggers, Carl J., *Physiology in Health and Disease*, p. 63.

[38] The roughness of this calculation is realized.

[39] In contradiction of the results reported by Travis, Tuttle, and Cowan, "A Study of the Heart Rate During Stuttering," *Journal of Speech Disorders*, March, 1936. Travis, et al, reported that stutterers when speaking had a more rapid pulse rate than normals when speaking. Further study is indicated.

of .03 second, since the groups are displaced .01 second to the right even after the .03 second calibration. The first group encountered is the one presented by the stutterers conversing, favorable to accent, from 2–19% inclusive. Although mathematically uncertain, this group is confirmed by a similar group of stutterers reading aloud (more



cases) of 13–19% inclusive. If .04 second is allowed as the lag, the group will occupy the reduced ejection phase of ventricular systole, and extend about .01 second into proto-diastole.[40]

Immediately following this group is an unfavorable group 20–43% inclusive. It begins shortly before the close of photo-diastole, and ends almost at the close of active diastole.

The favorable group 44–72% inclusive commences at the beginning of diastasis, and continues into auricular systole about .04 second. This would seem to coincide with the phase of auricular systole described by Wiggers, which is a rise of ventricular and auricular pressure following auricular contraction. The beginning approximately of the rise in pressure marks the end of the favorable group.

The next group, 72–90% inclusive, is not mathematically certain but parallels the normal grouping. It commences at the beginning of the rise in pressure of auricular systole, and continues until its close.

For the same reason, 97 and 98% can be mentioned, although not mathematically certain. They are also unfavorable.

This picture of energy distribution by stutterers in relationship to the heart should be accepted only as tentative pending further investigation. It may be assumed, however, that the cardiac cycle does determine their energy quanta distribution, but in a differing way.

Conclusions

The data show a lag of approximately .03 second, and allowing this, the following portions of the cardiac cycle determine the corresponding events in the distribution of large energy quanta in speech:

a. At the close of the maximum ejection phase of ventricular systole, when the pressure in the ventricles and the volume of blood ejected is reaching its maximum, is a period of the cycle which is unfavorable to the development of accent. This is followed immediately by:

b. The favorable point 00% located at or near the point of greatest ejection, and is followed immediately by:

c. A short group of about .03 second which is again unfavorable to the development of large energy quanta, and which occurs as the pressure and volume flow from the ventricle begin to decline.

[40] The diagrams accompanying these notes present the data for the stutterers with the .03 lag, which has been calibrated. The need for another calibration of .01 second is evident.

d. Slightly towards the first portion of active diastole are two favorable points: 31,33% (about .034 second after the inception of the phase).[41]

e. The last portion of the period of diastasis is favorable to accent, and the beginning of auricular systole closes this favorable group.

f. Auricular systole is unfavorable to accent. .01 second after the isometric contraction phase of the ventricles commences this cycle is again impartial.

g. Stutterers when speaking do not follow the tendencies of normal speakers, except very roughly. Nevertheless the cardiac cycle determines the distribution of energy in a definite significant pattern. Much further study is indicated here, since clinical findings of importance may result. The present results seem to indicate stuttering as a phenomenon of neuro-physiological order rather than a so-called volitional or emotional disturbance.[42]

Appendix

A number of additional investigations are immediately suggested:

1. The mechanism of the distribution should be studied.
2. Stutterers should be studied further.
3. It is only after about five minutes of speaking that these groups become mathematically significant. This should be studied.
4. No objective study after Muyskens has been made of meaning and energy distributions.
5. More exact quantitative measurements should be obtained with the cathode ray apparatus suggested here.
6. The relationship of the heart rate to the rhythmic recurrence of these accents should be studied. In the present records there was a slight positive correlation between the heart rate and the number of accents per minute.
7. During the measurement of the records, it was noticed that

[41] The literature contains no explanation of this phenomenon. Howell quotes an early experiment by Einthoven, which shows an increase in electrical current from the afferent vagus fibers near or at this point in the heart beat.

[42] In the diagrams the hatched areas represent the groupings confirmed by stutterers conversing. The questionable groups are indicated by open blocks. The grouping in both diagrams is superimposed upon a scaled time scheme of the cardiac cycle at this rate of the heart. The line of impartiality represents the chance distribution, the blocks above the groups favorable to accent, the blocks below those unfavorable. No comparative grouping is intended; simply the endurance time is represented.

there was a regular recurrence of large accents and smaller ones, a "family" so to speak. Is this the result of the Traube-Hering reflex, or does it come from some other unmeasured relationship with the vegetative functions? If other large movements such as those of the alimentary canal and the peristaltic tube were to be studied, perhaps a relationship would show. Certainly the knowledge of certain variant types of speech defects would lead one to this suspicion. There should be other determinants and regulators of the speech process. And other parts of the speech process closer or farther from primitivity should be studied in relationship to these determinants. The problem is of serious importance, due to its relationship to physiology and to pathological studies in speech.

A STUDY OF THE RELATION OF THE RELATIVE SIZE OF THE TWO HANDS TO SPEECH*

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SEVERAL years ago, the author noticed that his right hand was larger than his left hand. Afterwards he watched himself and found that the larger hand was performing acts which required gross movements and strength while the smaller hand was used in more dextrous activities. The observations indicated that there might be an existing relationship between the size of the two hands and laterality. A study[1] was conducted by the author at the University of Iowa to determine whether or not a difference in the size of the two hands was to be found generally. Of forty-six males studied, only 8.7 per cent were found to have both the right hand and the left hand equal in size.

Included in this study were thirty-four non-stutterers and thirty-three stutterers. A comparison of percentages of subjects having a larger right hand or left hand revealed no outstanding differences between the two groups. Since there is assumed to be a lack of dominant lead in the stuttering person, if we further assume that the difference in the size of the two hands is due to development through use, it might be expected that findings on non-stutterers and stutterers would not agree.

The Iowa study did not give a true indication of hand volume. The advisability of determining the amount of difference and comparing averages for non-stutterers and stutterers seemed apparent. Later, at the University of Michigan, an entirely new piece of apparatus was developed to measure the volume of the hand and a study was made of the hand volume of forty-four non-stuttering males and thirty-nine stuttering males.

* This is an abstract of a dissertation submitted in partial fulfillment of the requirements for the degree of doctor of science in the University of Michigan. The investigation was carried on under the direction of the following committee: Professors John H. Muyskens, Clarence L. Meader, Henry A. Sanders, Leon H. Strong, and Louis M. Eich. During its early stages, the investigation was conducted in the Graduate School of the University of Iowa under Dr. Wendell Johnson.

[1] Van Dusen, C. R., "A Study of the Relation of the Relative Size of the Two Hands to Speech," *Science*, 81, April 12, 1935, 363.

Apparatus and Experimental Procedure

The development of a technique for determining the volume of the hand progressed in a series of studies: Series I, Series II, and Series III. In this paper, only the refined Series III apparatus and experimental procedure will be described.

Before making measurements it was necessary to decide upon a point of demarcation between the hand and arm which could be readily determined and marked. The carpal was chosen because of the ease and seeming accuracy with which it could be determined and marked in successive measurements. A special piece of apparatus was developed for making the markings. This consisted of a large flat board with a groove in which were inserted two small pieces of wood. In each of these was placed an upright piece of wood about the size of a pencil. The arm and hand were placed in the device with the wrist just above the groove. The pegs were moved inwardly and clamped, one peg falling at the extreme edge of the distal extremity of the ulna, the other at the extreme edge of the distal extremity of the radius. A straight line was drawn through the axis of the forearm over the dorsal side of the wrist. A ruler was laid across the arm with one edge resting against the pegs. A mark was made at the crossing of these two lines. While the markings were being made, the subjects were seated in the standard position described by Bayer and Gray.[2]

Volume measurements were made by immersing the hand and measuring the amount of liquid displaced. The apparatus used in the present study is shown in Figure 1. A level steel plate table was made movable by a hydraulic jack. Liquid in which the hand was immersed was contained in a three-litre beaker. Previous to each immersion the liquid level in the beaker had been brought to the lower edge of the outlet pipe by closing the outlet end, filling to a point above the level desired, and then allowing the surplus to flow into a container used only for that purpose. As the table was raised, displaced liquid flowed into a glass funnel. The funnel, attached to the beaker below the spigot, directed the overflowing liquid downward, through tubing which passed through a hole in the table, into the 500 c.c. graduated cylinder below. After the desired point on the wrist was reached, the hand was withdrawn, and the reading made.

The subject was seated in the rear of the apparatus, facing left

[2] Bayer, L. M., and Gray, H., "The Hand: Method of Measurement," *American Journal of Physical Anthropology*, 17, 1932–33, 379–415.

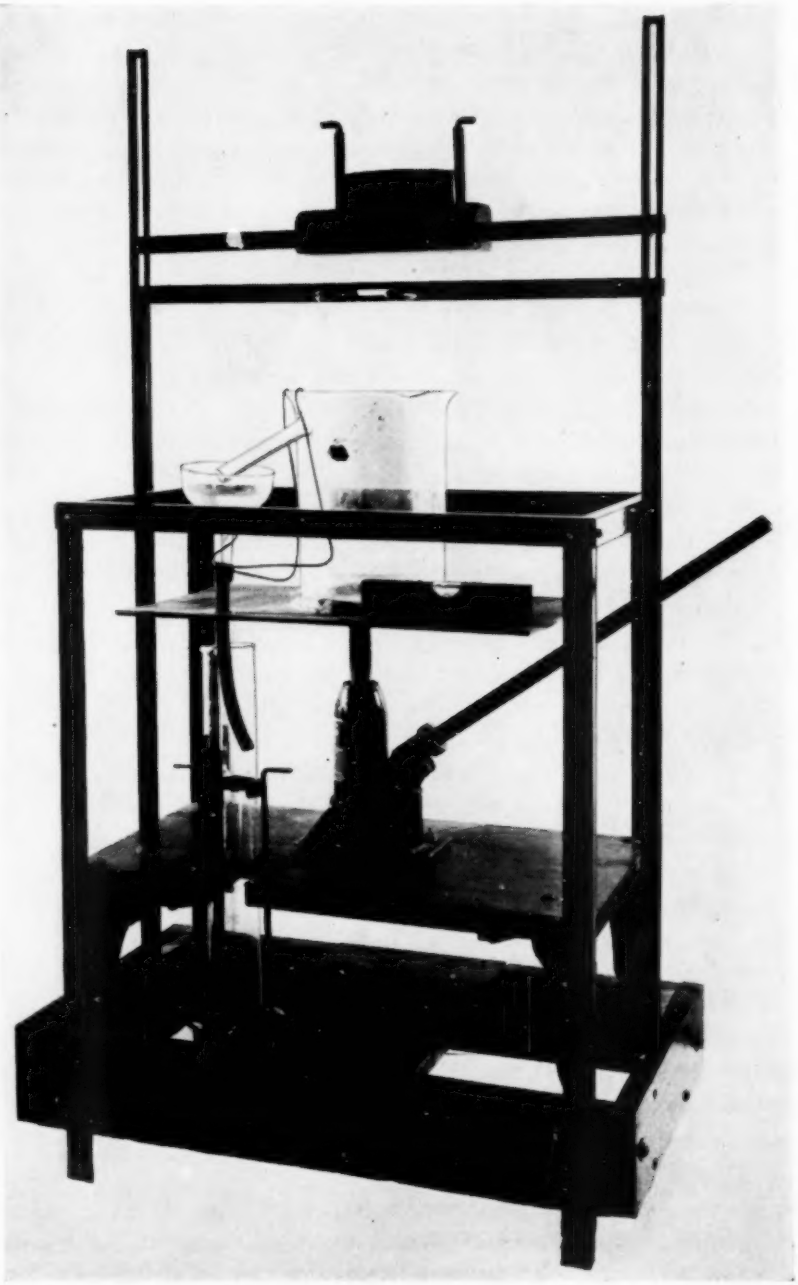

FIG. 1. Series III apparatus for determining the volume of the hand.

while the right hand was being measured, and facing right while the left hand was being measured. A wooden cushion with adjustable guides is shown above the table. The arm just above the elbow rested here. The arm was held steady in the adjustable clamps below. Slots in the upright side irons allowed for variations in the height of the wooden cushion and the adjustable clamps. Adjustments were made to suit the height and the arm length of individual subjects. A rubber sponge on the cushion lessened pressure on the arm.

Measurements were made as rapidly as possible. It was found advisable to have the beaker raised within an inch of the desired point so that as the hand was placed into the device a part of the displacement was completed. It was then necessary to raise the table but a short distance to complete the immersion. Measurements were made with the subjects seated in a well-lighted laboratory, the temperature of which was held at 68°F. The subject was required to remain quietly in a good sitting position ten minutes after marking, before the measurement was made. He was seated during this time in a straight-backed chair which had been placed in the correct position behind the apparatus. His hands were placed on his lap and he was asked not to move. He was told to remain relaxed throughout the procedure and that as the measurements were being made the experimenter would move the arm into place. He was told not to assist in the operation by use of his own energy.

After the displacement was completed, the arm was removed, the hand was dried, and the subject faced in the opposite direction. The subject sat quietly for ten minutes before the next measurement was taken. A new marking was made before each measurement. Water, held at body temperature, served as the displacement medium. The hand was left immersed for forty seconds.

Before making any measurements of the hand, the device was tested by making measurements on a solid. A kilogram weight with attachment was suspended from the mid-point of the adjustable clamp slot and measurements accomplished in a manner as similar as possible to that used with humans. Consistent volumes of 145 c.c. were obtained in the successive measurements.

To test further the reliability of the apparatus, repeated measurements were taken on forty right-handed non-stuttering males. A coefficient of $.9950 \pm 0.0016$ was obtained when first and second measurements taken on the right hand were correlated. A coefficient of $.9798 \pm 0.0064$ was obtained when first and second measurements

taken on the left hand were correlated. The mean of first measurements of right hands was 431.6 ± 8.2691; the mean of second measurements of right hands was 430.3 ±8.0790. The mean of first measurements of left hands was 414.3 ± 8.2002; the mean of second measurements of left hands was 417.0 ± 8.1408.

Characteristics of Cases

The volumes of the two hands of forty-four non-stuttering males and thirty-nine stuttering males were studied in the Series III investigation. Forty non-stutterers and thirty-seven stutterers were right-handed. Because of the small number of subjects in other classifications (left-handed and ambidextrous males in both groups, and all females) only the right-handed non-stuttering males and the right-handed stuttering males will be dealt with here.

Subjects in the non-stuttering group were students in the University of Michigan and Michigan State College. Subjects in the stuttering group were students at Michigan State College and at the Lewis Institute in Detroit. Ranges, means, and standard deviations for ages, heights, and weights of the two groups are presented in Table I.

All subjects were white and of American birth. Care was taken not to include subjects whose handedness had been changed nor whose bones in the arms or hands had been broken. Laterality tests were administered to all subjects.[3] Age was taken as the nearest birthday. Heights were obtained with the shoes removed. Weights were taken with the subjects uniformly clothed, 1.6 per cent of the obtained weight was subtracted to allow for clothing.[4]

Findings

Before comparing the two groups it was necessary to determine first whether or not mean differences for each group were significant. In studying the significance of differences between the averaged volume of the right hand and the averaged volume of the left hand

[3] A questionnaire study of hand-usage, tests of strength, speed, accuracy, and laterality lead were given. Findings from these tests have been studied in relation to hand volume and linear dimensions of the hand. This part of the investigation will be presented in a later publication. In the present study the subject's statement of hand-usage served as the indication of handedness.

[4] Subjects studied in Series I and Series II were quite similar to Series III cases in age, height, and weight.

of non-stutterers, the mean of the differences was obtained. This was found to be 14.8 c.c. A t-score[5] of 8.670 was obtained which indicates that the difference between the right and left hands of this group was highly significant. In studying the significance of the differences between the averaged volume measurements of the right and left hands of stutterers, a mean difference of 15.1 c.c. was obtained. The t-score, 8.737, obtained for this group, indicates that the difference between the right and left hands is highly significant.

The next step was to determine whether or not there was a significant difference between the two groups. A study was made of amounts of difference between the right hands and the left hands of non-stutterers as compared to the amounts of difference between the right hands and the left hands of stutterers. Fisher's formula[6] for comparing two means for separate groups was applied and a t-score of .1092 was obtained. This t-score indicates that the difference between the means of the differences for the two groups is not significant. Even though there is a significant difference between the mean volume of the right hand and the mean volume of the left hand in both groups, there is no significant difference when differences for non-stutterers are compared to stutterers.

Absolute and percentage frequencies of subjects having larger right hands, larger left hands, or both hands equal are presented in summary form in Table II. Percentages obtained for the right-handed group and for the left-handed group indicate either that the hand which is most used is larger or that the larger hand is most used, whichever the case may be. The per cent of subjects having both hands equal in volume is very small. In only the Series I study were there any subjects showing both hands to be equal in volume. It is probable that this is because the apparatus used was not as sensitive as was the Series II and Series III apparatus.

Absolute and percentage frequencies for all non-stutterers and stutterers are presented in Table III. A greater per cent of the right-handed male stutterers were found to have a larger right hand than left hand than were the non-stutterers. It seems that if there is a "lack of dominant lead in the stuttering person" handedness activity would be disintegrated more frequently in the stuttering group than in the non-stuttering group. It seems that right-handed stutterers would

[5] Fisher, R. A., *Statistical Methods for Research Workers*, London: Oliver and Boyd, 139, 1928, 104–107.

[6] *Ibid.*, 107.

have a larger right hand than left hand less frequently than would non-stutterers. Findings in this investigation do not bear out these assumptions.

Summary and Conclusions

1. Absolute and percentage frequencies indicate that the volume of the two hands is different generally.

2. This difference is statistically significant for a group of non-stutterers and for a group of stutterers.

3. When the mean of differences between the right hands and left hands of the non-stuttering group was compared with the mean of the differences between the right hands and left hands of the stuttering group no significant difference was obtained.

4. Absolute and percentage frequencies revealed a larger per cent of right-handed stuttering males having a larger right hand than left hand than there were right-handed non-stutterers having a larger right hand than left hand.

These findings would seem to indicate that, if the difference in the size of the two hands is due to use, the degree of assumed superior dominance of the left cerebral hemisphere over the right cerebral hemisphere is not sufficient to cause enough difference in laterality usage to result in any significant volume difference for non-stutterers and stutterers.

TABLE I

This Table Shows Ranges, Means, and Standard Deviations for Ages, Heights, and Weights of Right-handed Non-stuttering Males and Right-handed Stuttering Males Studied in Series III

	Group	Range	Mean	Standard Deviation
Age (years)	Non-stutterers	19 — 26	21.1±0.2469	1.5218±0.1746
	Stutterers	15 — 32	21.8±0.5833	3.5959±0.4125
Height (cm.)	Non-stutterers	155.6—189.2	176.3±1.0316	6.4424±0.7295
	Stutterers	153.3—193.0	175.8±1.2664	7.4919±0.8955
Weight (kg.)	Non-stutterers	54.9—114.3	72.0±1.9078	11.9145±1.3490
	Stutterers	53.1— 81.2	66.1±1.2389	7.3296±0.9861

TABLE II

THIS TABLE SHOWS THE TOTAL NUMBER OF RIGHT-HANDED SUBJECTS, THE TOTAL NUMBER OF LEFT-HANDED SUBJECTS, AND THE TOTAL NUMBER OF AMBIDEXTROUS SUBJECTS.

The per cent of subjects having a larger right hand, a larger left hand, or both hands equal is shown for each classification. This table is a summary of all adult subjects measured with the Series I, Series II, and Series III techniques.

CLASSIFICATION	NUMBER OF SUBJECTS	R > L		R = L		R < L	
		No.	PER CENT	No.	PER CENT	No.	PER CENT
Right-handed Subjects	185	166	89.73	2	1.08	17	9.19
Left-handed Subjects	15	4	26.67	3	20.00	8	53.33
Ambidextrous Subjects	11	6	54.55	1	9.09	4	36.36
Total	211	176	83.41	6	2.84	29	13.74

TABLE III

THIS TABLE SHOWS ABSOLUTE AND PERCENTAGE FREQUENCIES OF SUBJECTS HAVING A LARGER RIGHT HAND VOLUME, A LARGER LEFT HAND VOLUME OR WITH BOTH HANDS EQUAL IN VOLUME.

This is a summary table and includes all subjects in Series I, Series II, and Series III.

CLASSIFICATION	NUMBER OF SUBJECTS	R > L		R = L		R < L	
		No.	PER CENT	No.	PER CENT	No.	PER CENT
NON-STUTTERERS							
Right-handed males	79	70	88.61	1	1.27	8	10.13
Left-handed males	8	4	50.00	1	12.50	3	37.50
Ambidextrous males	5	4	80.00	0	.00	1	20.00
Right-handed females	44	40	90.91	0	.00	4	9.09
Left-handed females	3	0	.00	0	.00	3	100.00
Ambidextrous females	1	0	.00	0	.00	1	100.00
Total	140	118	84.29	2	1.43	20	14.29
STUTTERERS							
Right-handed males	54	49	90.74	1	1.85	4	7.41
Left-handed males	4	0	.00	2	50.00	2	50.00
Ambidextrous males	4	1	25.00	1	25.00	2	50.00
Right-handed females	8	7	87.50	0	.00	1	12.50
Left-handed females	0	0	.00	0	.00	0	.00
Ambidextrous females	1	1	100.00	0	.00	0	.00
Total	71	58	81.69	4	5.63	9	12.68
Grand Total	211	176	83.41	6	2.84	29	13.74

SPEECH EDUCATION IN PUBLIC SECONDARY SCHOOLS WITH EMPHASIS ON THE TRAINING OF TEACHERS OF SPEECH

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I. The Problem

The general problem of this study in speech education is the examination of the training of teachers of speech in the secondary school, and the suggesting of improvements. The specific purposes were: first, to discover through an analysis of the aims, organization, and content of secondary school curricula, reliable information concerning the training necessary; secondly, to study the present training afforded the teachers of speech in the secondary schools of the United States; and, thirdly, to evaluate the training now offered in terms of the needs which appear upon the examination of curricula.

SINCE the appearance of the earliest rudiments of human society, some form of speech, either oral or written, has served as the medium of communication of ideas, knowledge, and tradition. Today speech may be considered one of the most important factors of civilization, for only through words may thoughts and experience be transmitted from one human being to another, and only in this manner can one generation build upon the foundations laid by those preceding it. Indeed, according to Searson, who made a study of the statements of six thousand individuals who were questioned by him, 50 to 93 per cent of all human activities involve oral communication.[1] Furthermore, in a curriculum study published by Bobbitt in 1926, there was included an analysis of reference to topics of human interest found in the *Readers' Guide* for the years of 1919–1921, in which it was revealed that of the 3,289 items classified, 1,101 were related to speech and language activities.[2]

Speech education in the public school. The growing importance of speech education in the public schools is evidenced by the organized efforts to promote and stimulate this division of instruction at both the elementary and secondary levels. Excellent presentation of the consideration now being devoted to the problem of speech education in the elementary school is found in a recent study published by

[1] J. W. Searson, "Meeting the Public Demands," *English Journal*, 10, June, 1921, 327–332.

[2] Franklin Bobbitt, et al., *Curriculum Investigations*, Supplementary Educational Monographs, No. 31, Chicago: University of Chicago, June, 1926, p. 14.

Meader.[3] Concerning the importance of speech education during the secondary years, investigations are being published such as the report by Drummond[4] and the *Speech Bulletins*[5] prepared by the Committee for the Advancement of Speech in Secondary Schools and *A Course of Study* in Speech for Secondary Schools.[6]

Speech education in higher institutions. Although until recently the departments of speech in the colleges and universities of the nation were often among the smallest in those institutions, at the present time speech has become more prominent in the curricula of colleges and universities. At the University of Missouri, for example, all majors and minors in the department of English are required to take a course in public speaking,[7] while at the University of Wisconsin one of the requisites for admission to the School of Education is the demonstration of proficiency in speech. A further example is to be seen at the University of Southern California where candidates for the course in practice teaching are required to pass an examination in speech; all failing students must take remedial work in the department of speech. At the same institution six units of work in speech are a part of the teacher-training course. The Missouri State Department of Education recommends at least six units of speech in the training program of teachers of English, while it requires teachers in speech to take at least fifteen hours.[8]

In view of the growing importance of speech education at all levels of study, investigation in the field is both timely and valuable. For the most part, statistical material has been meager and incomplete, no investigation having been nation-wide in scope, and only ten of the studies examined being of an objective nature.

The training of teachers of speech in secondary schools. The status

[3] Meader, Emma Grant, *Teaching Speech in the Elementary School,* Teachers' College Contributions to Education, No. 317. New York: Teachers College, Columbia University, 1928.

[4] Drummond, A. M., editor, *A Course of Study in Speech Training and Public Speaking for Secondary Schools,* New York: The Century Company, 1925.

[5] Cortright, Rupert L., editor, *Speech Bulletins,* National Association of Teachers of Speech, 1928–1932.

[6] Borchers, Gladys L., Chairman, "A Course of Study in Speech for Secondary Schools, The Secondary School Committee Report," *Quarterly Journal of Speech,* 22, April, 1936, 250–266.

[7] "News and Notes," *Quarterly Journal of Speech,* 18, November, 1932, 694–695.

[8] "News and Notes," *loc. cit.*

of state-wide teacher-training in the field of English was the subject of a study by Parks, who found that only three states, viz., New York, New Jersey, and Pennsylvania, had such a program in operation.[9]

The sentiment of the Committee for the Advancement of Speech in Secondary Schools, the body which has exhibited keen interest and activity in the promotion of speech education, has been well represented in a statement by the present chairman of the committee, Gladys L. Borchers, in reporting to the Los Angeles convention in December, 1932, pointed out "the need for continuing to place emphasis in secondary speech education on excellent speech training."[10]

Sources of Information and Method of Procedure

Material has been drawn from varied and numerous sources, and an effort has been made to avoid any suggestion of bias. It has been the endeavor of the writer to make the study a comprehensive and reasonably accurate presentation of the subject in its past and present aspects.

Following is a description of the principal sources consulted in the preparation of this study:

1. *The rating scale.* This scale was devised to secure from respondents an evaluation of secondary school speech curricula and of teacher training in that subject.[11] Copies of the rating scale were sent to college and university instructors of courses in speech and in English methods, to heads of speech and English departments in colleges and universities, and to secondary school instructors in speech. One hundred fifty-nine usable replies, representing sentiment in forty-one states, were received.

PRINCIPAL TOPICS OF THE RATING SCALE

I. General Speech Aims for Public Secondary Schools
II. Aims in Special Speech Subjects
  A. Speech Science[12]
  B. Interpretation
  C. Original Speech
  D. Drama

[9] Parks, Carrie Belle, "The State-wide Program in Teacher Training in English," *English Journal*, 21, February, 1932, 150–152.

[10] Borchers, Gladys L., "Committee Report of Executive Council Meeting," *Quarterly Journal of Speech*, 19, February, 1933, 131–132.

[11] See original study, "Speech Education in Public Secondary Schools with Emphasis on the Training of Teachers of Speech," unpublished dissertation, University of Southern California Library, 1934. A second copy on deposit in United States Office of Education Library, Washington, D. C. Both are available through inter-library loan.

[12] The field of speech was defined for purposes of the study, page 10 of original study, so that each classification would be mutually exclusive.

III. Content and Organization of Curriculum

A. Junior High School
B. Senior High School
C. Junior College

IV. The Professional Training of the Teacher of Speech

A. Requirements for degrees and certificates
B. Practice Teaching
C. Strength of teacher training program
D. Weakness of teacher training program
E. Speech training required of all secondary teachers

V. Classified List of Textbooks in Speech

A. General
B. Speech Science
C. Interpretation
D. Debate and public speaking (Original speech)
E. Drama

2. *Statement of training and experience.* Accompanying the rating scale, a blank was sent which requested certain information concerning the training and experience of the respondents. Seventy usable replies were received.

3. *Analysis of textbooks.* Five of the leading textbooks in the field of speech, representing the five fields—speech science, interpretation, original speech, drama, and the teaching of English and speech—were analyzed to determine the relative importance of the various topics treated, the criterion used being the number of pages devoted to the topic.

4. *Evaluation of secondary school speech problems.* In order to further check the speech situation in the secondary school, a list of the eighteen topics to which the greatest number of pages devoted in the textbooks previously analyzed, was submitted to thirty-three graduate students and experienced instructors in speech, who were asked to state the relative emphasis which, in their opinion, should be given these topics at the junior high school, senior high school, and junior college levels.

5. *Catalogue studies of offerings in speech education.* Three separate catalogue studies were made: (1) that of 507 universities and teachers' colleges, or 61 per cent of the total number of such institutions; (2) that of the twenty universities offering work toward graduate degrees in speech; (3) that of 292 junior colleges, or 30 per cent of the total number of junior colleges.

6. *State and city courses of study in speech and English.* Sixty-two state and city courses of study were examined with regard to aims and curriculum content. In regard to the secondary school, it was necessary in a number of cases to examine the parts of the courses of study in English which pertained to speech education, since few courses of study in speech have been adopted in secondary schools.

7. *Library research.* Library materials concerning every phase of the investigation have been consulted and studied. Committee reports, especially the nine reports of the Committee for Teacher Training, National Council of Teach-

ers of English, were of particular assistance. Of equal importance were the publications of the Committee for the Advancement of Speech in Secondary Schools.[13]

8. *Visitation of secondary schools and of colleges.* Nineteen universities and twenty-eight secondary schools in various parts of the United States were visited by the investigator in the course of the study.

Aims in Speech Education Derived from the Present Study

A survey was made by the writer of the aims of speech education expressed by sixty-four authorities in the field, these individuals having been selected upon the basis of replies to the rating scale, and of periodical material. The investigation revealed that of forty-one aims of speech education considered in the literature, the ten most frequently mentioned were those listed below:

Aim	Aspect of Speech	Percentage of Mention
1. Ability to meet practical situations	(general)	90.6
2. Dramatic technique	(drama)	46.9
3. Standard Dramatists	(drama)	39.1
4. Articulation	(speech science)	34.4
5. Appreciation of literature	(interpretation)	32.8
6. Enunciation	(speech science)	32.8
7. Study of plays	(drama)	31.3
8. Debate and forum	(original speech)	28.1
9. Conversation	(original speech)	26.6
10. Verse and prose	(interpretation)	26.6

The complete list of aims mentioned by the sixty-four writers is given in Table I. It may be noted that the four least frequently mentioned aims taken from the study of textbooks and periodicals, and which have a rating of 3.1 per cent of the replies, are puppetry, library work, classroom use, and general culture.

Aims discovered in state and city courses of study. In order to draw up a more definite and more practical list of aims of secondary school speech education, sixty-two state and city courses of study were consulted. The frequency of mention of the thirty-five aims given in them are presented in full in the original study.[14] The aims are mentioned in Table I.

Evaluation of speech aims by collegiate and secondary instructors. As a further check on aims given by authorities and in courses of study the evaluation of objectives by collegiate and secondary instructors is of interest. As has been mentioned before, the returns of

[13] Borchers, Gladys L., Chairman, "A Course of Study in Speech for Secondary Schools, The Secondary School Committee Report," *Quarterly Journal of Speech*, 22, April, 1936, 250–266.

[14] Ritter, *Speech Education in Public Secondary Schools.*

the writer's rating scale were divided into two major classifications; namely, those from speech instructors in colleges and universities, and those in secondary schools.

In order to establish well accepted aims of speech instruction, the two highest ranking aims in each of the five groups will be given

TABLE I

LIST OF AIMS IN SPEECH COMPILED FROM AN ANALYSIS OF TEXTUAL AND PERIODICAL LITERATURE (Sixty-four Authorities)

RANK	AIM	NUMBER OF WRITERS LISTING AIM	PER CENT OF WRITERS LISTING AIM
1	Practical situations	58	90.6
2	Dramatic technique	30	46.9
3	Standard dramatists	25	39.1
4	Articulation	22	34.4
5	Appreciation of literature	21	32.8
6	Enunciation	21	32.8
7	Study of plays	20	31.3
8	Debate and forum	18	28.1
9	Conversation	17	26.6
10	Verse and prose	17	26.6
11	Phonetics	16	25.0
12	Contemporary works	16	25.0
13	Analysis and outlines	15	23.4
14	Freedom of voice and pantomime	14	21.9
15	Modulated voice	13	20.3
16	Remedial measures, major speech defects	13	20.3
17	Remedial measures, minor speech defects	13	20.3
18	Listening to speakers	12	18.8
19	Think and act forcefully and logically	12	18.8
20	Imagination and sympathy	12	18.8
21	Audience psychology	11	17.2
22	Development of extra-curriculum activities	10	15.6
23	Stories and anecdotes	10	15.6
24	Conduct of meeting	9	14.1
25	Published addresses	8	12.5
26	Cooperation with others	8	12.5
27	Avocational uses of speech	8	12.5
28	Playwriting	8	12.5
29	Stagecraft	8	12.5
30	Costume and makeup	7	10.9
31	Projection of personality	7	10.9
32	Physics and anatomy of sound	6	9.4
33	Development of personality	6	9.4
34	Radio technique	6	9.4
35	Character development	5	7.8
36	Appreciation of drama	5	7.8
37	Parliamentary drill	4	6.3
38	Creative listening	4	6.3
39	Puppetry	2	3.1
40	Library work	2	3.1
41	Classroom use	2	3.1
42	General culture	2	3.1

at this point. It should be stated that the ranks were determined by calculating composite ratings or index numbers.

	INDEX NUMBER [15]
General Aims	
Practical situations	901
Personality development	742
Speech Science	
Enunciation	852
Articulation	817
Interpretation	
Voice modulation	862
Verse reading	860
Original Speech	
Debate and forum	727
Skill in conversation	599
Dramatics	
Study and acting of plays	801
Study of great dramatists	700

The two highest ranking aims for each phase of speech education, according to college and university instructors, were:

	INDEX NUMBER
General Aims	
Practical situations	789
Personality development	593
Speech Science	
Enunciation	745
Articulation	714
Interpretation	
Verse reading	747
Voice modulation	746
Original Speech	
Debate and forum discussions	630
Skill in conversation	599
Dramatics	
Study and acting of plays	649
Study of great dramatics	603

The relative importance of each of the six general aims of speech education, according to the ratings of secondary and college instructors, is seen in the following results. These instructors judge that aims should be regarded in this order: practical situation, personality development, character development, creative listening, library work, and parliamentary drill.

In comparing the ranks given to general aims by secondary and college teachers one notes an exact correlation in rank; that is, "practical situations" was ranked highest, and "personality development" second by both secondary school and college and university instructors. Under speech science the first three ranks are the same,

[15] The index numbers were calculated by giving the values 15, 12, 10, 8, 6, 4, 3, 2, 1, respectively, to first place ranking, second place ranking, etc.

with ratings four and five reversed; under "interpretation" the first and second ratings were reversed, the third remaining the same; and under "dramatics" there is an exact correlation. When the index numbers or composite scores representing the rating by secondary instructors were correlated with the composite scores which represented the ratings by collegiate instructors, a correlation of *.945–014* was obtained. This figure shows very close agreement between opinions of secondary school and college instructors with regard to the relative importance of aims in speech education.

Criteria Derived from the Organization of the Secondary School Curriculum in Speech

Part III of the rating scale pertained to the organization of speech curricula. In this section of the rating scale the respondents were asked to state (1) the number of weeks actually allotted to the several phases of speech education at the three secondary levels, and (2) the number of weeks which they would recommend as an ideal situation. In recognition of the fact that speech is taught with English or other subjects in the smaller schools, a twofold division was made in this portion of the scale; namely, "speech as taught with English or other subjects" and "taught separately as speech." Respondents were asked to state actual situations and to make recommendations under each of these two headings.

Criteria Derived from the Content of the Secondary Curriculum in Speech Education[16]

An excellent and rather complete comprehension of a well-organized English course, including the various phases of composition,

[16] Since the original data for this study has been gathered other courses of speech have appeared:

1. Preston H. Scott, Wayne University, General Chairman, The Michigan Association of Teachers of Speech, "Suggestive Outlines in Speech for the Elementary, Intermediate, and Secondary Schools," mimeographed, May, 1936.
2. Horace C. Rahskopf, University of Washington, Seattle, Chairman, "An Integrated Course of Study in Speech," mimeographed.
3. Carmie S. Wolfe, Chairman, Part II *English Handbook for Teachers of English,* Junior and Senior High School, Department of Education, State of Kansas, Topeka, Kansas, 1935.
4. John E. Coxe, State High School Supervisor, Bulletin No. 307, "Course of Study in English in Louisiana High Schools," State Department of Education, Baton Rouge, Louisiana, October, 1935.

literature and speech, is gained from an examination of that of the University High School in Berkeley, California.

The arrangement of speech work indicated in the Berkeley course of study and in those which follow, represents the common trend in many large cities. The speech instruction for grades seven, eight, and nine, is incidental to the regular course work in English composition and literature; and it is, for the most part, at the play level. For example, the purpose of "High S" is twofold: first, "To set a standard for plays," and second, "to manage a class or school theater." The aims of "High 9" are likewise "to manage a class or school assembly" and "to set a standard for speech."

In the senior high school (grades ten, eleven, and twelve), somewhat the same situation exists. However, it will be noted that in High 10 a considerable unit is offered in oral expression. This is true also for the thirty-six high schools in the City of Los Angeles.[17] In addition, as shown in the Smith survey, certain courses in public speaking, dramatics and debates are put on an elective basis in the eleventh and twelfth grades.[18]

The speech education work at the junior college level parallels somewhat the work customarily offered in colleges and universities, and is likewise of a professional and appreciation nature. An examination of the bulletin of the Los Angeles Junior College[19] for 1932–1933 reveals that five English courses are followed by the annotation, "parallels English ———— (course number), University of California at Los Angeles." This practice is followed frequently by other junior colleges in California and indicates courses that will receive credit as the university offerings. The latter are certificate courses and are open only to those with high school records of recommended level. Courses without the subscription are "open to all students but not all four-year colleges will give advanced credit for them"; those courses are called "semi-professional courses."

Typical speech education curricula in junior high schools. Three of the most typical speech education curricula in junior high schools are those of Cleveland Heights, Ohio, Los Angeles, and Long Beach, California.

[17] *Course in B-10 English,* English Monograph, Los Angeles City Schools, 1925.

[18] *Announcement of Courses, 1932,* Los Angeles Junior College, Los Angeles, California, 1932, pp. 65 ff., pp. 96 ff.

[19] *Ibid.,* 25.

(1) *Cleveland Heights, Ohio.* The speech units selected and called to the attention of the reader from the junior high school course of study of Cleveland Heights, Ohio, are those entitled "Tales from Shakespeare," "Midsummer Night's Dream," "Twelfth Night," "Contemporary Verse," and "One-Act Plays."[20]

The first unit, "Tales from Shakespeare," may be studied however, as a sample of the work in speech education at the junior high school level. The aims of this particular unit are "to teach students to enjoy a story, and to introduce them to Shakespeare and the early theaters.[21] The texts followed are "As You Like It" and "The Tempest" from Charles and Mary Lamb's volume, *Tales from Shakespeare,* while reference is also made to supplementary readings.[22] Under Section C of the unit, "Suggested Methods and Activities," the following classroom projects are noted: the reading and discussion of the story, the discussion of characters, the dramatization of scenes, reading selections from the original, memorizing speeches and songs, and the like. The other units of the course are organized in a similar way and treated in the manner of a teacher's workbook.

(2) *Los Angeles, California.* The general purpose of the junior high school English course of study in the A8 grade in Los Angeles is to afford intensive training in the technique[23] of spoken English. Following this aim, a list of objectives is set forth, the first of which, stated as the ability to organize thought, is explained as follows:

> All A8 pupils should be able to organize simple subject matter so that the sequence of detail is coherent. Pupils should be able to exclude all extraneous details. They should be able to evaluate their thoughts as of major and minor importance. In general, only the average and superior pupils will make use of simple topical outlines as a means for organizing and evaluating thought.[24]

[20] *Junior High School Course of Study, English,* Cleveland Heights, Ohio, 1930.

[21] Ward, Winifred, in *Creative Dramatics for Upper Grades and High School* (New York: D. Appleton and Co., 1930, 304 pp.) shows the following to be the purposes of the eighth grade course in Shakespeare outlined in the volume; to give the pupils an appealing introduction to Shakespeare, so that they will approach with interest their later and more detailed study of the plays.

[22] *Junior High School Course of Study, English,* Cleveland Heights, Ohio, 1930, pp. 18, 56, 77.

[23] *Secondary School Course of Study, Junior High School Grades, Junior High School English,* Los Angeles City School District, School Publication No. 202, 1931.

[24] *Ibid.,* 107.

The other objectives given are to cultivate the ability (1) to give class talks and reports, and to converse naturally and courteously with classmates; (2) to speak in a pleasing manner; (3) to use effective language; (4) to interpret literature; and (5) to observe simple parliamentary law.

(3) *Long Beach, California.* One of the most elaborately planned and carefully executed courses of study examined was that of the city schools in Long Beach, California.[25] In addition to the customary aims, teachers' projects, references, and other items, a large number of charts is furnished, showing clearly the various tasks to be attempted in each semester of work. Under the heading "Conversations, Interviews, and Social Courtesies," for example, the projects for 7A English are: (1) inquire of a friend concerning work done during your absence; (2) ask the librarian about good books to read; (3) introduce two friends; (4) thank the teacher for help with lesson; (5) invite a friend to go on a picnic with the family. It is readily seen that these projects are at the junior high school level, and of use and interest to the student of that age.

Typical speech education curricula in senior high schools. Of the senior high school courses of study available, those from the following cities have been selected for inspection: Cleveland Heights, Ohio; Long Beach, California, and Alhambra, California.

(1) *Cleveland Heights, Ohio.* Under each of the projects in the senior high school course of study in English the following aspects receive treatment: aims, supplementary reading activities, requirements, tests, supplementary aids, and outcomes. The detail in which the course has been worked out is evident from a study of Section D, the Julius Caesar project, which gives maximum, average, and minimum requirements for the twenty recitations. Other typical units of the course at Cleveland Heights are those on "One-Act Plays" and "Hamlet." Complete courses in debating and dramatics, are given.

(2) *Long Beach, California.* The following units have been chosen from the Long Beach course of study: "Oral Composition," tenth year; "Public Speaking," elective; "Public Speaking and Debate," elective; and "Drama," elective. In the outline on each of the four units, the time allotment, aims, sources of material, content, and method are discussed. For example, in "Oral Composition," offered in the tenth year, the following interesting and practical projects are

[25] *English Course of Study for Junior High School Grades 7, 8, and 9,* Long Beach City Schools: Long Beach, California, 1927.

given: "Sight Reading of Prose"; "The Reading of Poetry"; "A Successful American Life"; "The American Constitution"; "A Report on a Magazine Article"; "A Formal Debate"; and "An Impromptu Speech." It will be noted that all of these projects are practical and usable, lacking the emphasis on technique and voice culture characterizing the old elocution.

(3) *Alhambra, California.* The senior high school course of study in Alhambra, California, lists eight separate and distinct courses in speech education, including "Shakespeare," twelfth year; "Stage Mechanics," eleventh year; and "Stagecraft," twelfth year,[26] With the exception of "Oral English," which is required in the ninth year, the courses are elective.

Typical speech education curricula in junior colleges. Courses of study in speech education from the following cities have been selected as exemplary of the work of the larger junior colleges: Los Angeles and Pasadena, California, and Omaha, Nebraska. The junior college in Taft, California, was chosen as typical of the work of the small junior colleges.

(1) *Los Angeles Junior College.* In the Los Angeles Junior College, the following courses are offered under the heading of English: "Public Speaking," "The Drama," "Shakespeare," and "Debate." In the department of speech education there are offered courses in "The Theater," "Pantomime," "Applied Acting,' "Voice and Diction," "Interpretation," "History of the Drama," "Story Telling," "Playwriting," "Play Directing," "Community Drama," and "Make-up."[27] Large pupil enrollment and the enthusiasm of teachers and administrators are factors underlying this rather extensive program of speech education at Los Angeles Junior College.[28]

(2) *Taft Junior College.* Taft Junior College, which is representative of the smaller junior colleges, with an enrollment of 272 students, offers only two courses in speech education. These are two courses in public speaking, one giving the fundamentals of the art, and the other affording practice in argumentation.[29]

Needs for teacher training. From the examination of the junior high school courses of study it is evident that the work in speech

[26] *Alhambra High School, Drama.* (n.d., mimeographed), 7 pp.

[27] *Announcement of Courses,* 1932, Los Angeles Junior College, Los Angeles, California, 1932, pp. 65 ff., 96 ff.

[28] The enrollment at Los Angeles Junior College is the largest of all the junior colleges in the United States.

[29] *Taft Junior College Bulletin,* Taft Junior College, 1932–1933.

education involves, for the most part, play and appreciation. For this reason, speech education, with the possible exception of some corrective work, could therefore be handled in the junior high school by a regular English teacher who has had several courses and some experience in the field of speech. As for the corrective work, Murray shows that it is well managed in large cities.[30] In rural districts, however, it is still a real problem.

The work in the senior high school is still at the play and appreciation level although it tends to be more specialized and therefore, as is shown in the extra-curricular program, centers largely around the fields of debate and drama. The instructor in the senior high school needs more adequate and more specific training than does one in the junior high school. While speech education work is largely incidental in junior high school, and assumes a technical nature in junior college, at the senior high school level it is an all-absorbing interest.

A Study of Speech Curricula in 292 Junior Colleges

The preceding section has examined typical speech curricula in speech education in various schools of the secondary and junior college level. In addition, for the present section, it was possible at the junior college level to supplement examination of sample courses of study by a more objective investigation of offerings in speech education, namely, a study of 292 junior college catalogues, representing thirty-five states.[31]

Table II shows the total number of units offered by 292 junior colleges in each of the subdivisions of speech education. The five courses ranking highest in number of units offered are:

	Total Units
Public speaking (general)	577
Play production (elementary and advanced)	266
Argumentation and debate	216
Interpretation and literature	181
Principles of public speaking (fundamentals)	107

In the extreme right-hand column, "percentage of the total number," Table II shows the relative importance as far as number of units is concerned for the various courses listed.

[30] Murray, James, "The Status of Corrective Speech Instruction in Public Schools of the United States," unpublished Master's Thesis, University of Southern California, Los Angeles, California, 1930, 18–19.

[31] Weaver, J. Clark, "A Survey of Speech Curricula," *Quarterly Journal of Speech*, 18, November, 1932, 607–15.

With the purpose of ascertaining the relative importance of the major phases of speech education, the fifty-three courses were grouped under five headings in the table: Speech Science, Interpretation, Original Speech, Drama, and The Teaching of English and Speech. The total number of units offered in each of the five phases of speech education and the percentages computed show that original speech is the most important at the junior college level, 51 per cent

TABLE II

TOTAL NUMBER OF UNITS OFFERED BY 292 JUNIOR COLLEGES UNDER EACH CLASSIFICATION

NAME OF COURSE	NUMBER OF UNITS	PER CENT OF TOTAL
Public speaking (general)	577	33.14
Play production (elementary and advanced)	266	13.91
Argumentation and debate	216	11.30
Interpretation of literature	181	9.47
Principles of public speaking (fundamentals)	107	5.60
History of the theatre and the drama	94	4.92
Voice training and diction	60	3.14
Scene and stage design and lighting (stagecraft)	38	1.99
Private lessons	36	1.88
Story telling	31	1.62
Miscellaneous	31	1.62
Extemporaneous speaking	28	1.46
Oral reading (expression)	22	1.15
Forms of public address (forum)	19	.99
Drama (contemporary)	18	.94
Play writing (criticism)	18	.94
Program building	15	.78
Play direction	14	.73
Dramatic reading and platform art	14	.73
Costume design and makeup	14	.73
History of pageant (pageantry)	13	.68
Drama (general)	10	.52
Voice and speech science	10	.52
Orators (history)	8	.42
Phonetics	8	.42
Analysis and appreciation of literature and drama	8	.42
Psychology of speech and persuasion	7	.37
Teaching of speech	7	.37
Acting	7	.37
Business and professional speech	6	.31
Speech correction (clinic)	6	.31
Teaching of English	4	.21
Orations and oratory	4	.21
Interpretation of Tennyson	4	.21
Dramatic art (general)	4	.21
Interpretation of Shakespeare	3	.16
Intercollegiate debate	2	.10
Speech construction and composition	2	.10
Parliamentary law	1	.05

of the number of units being devoted to that subject; drama ranks second, with 26 per cent. The other phases with their respective percentages are: interpretation, 14 per cent; speech science, 5 per cent; miscellaneous, 4 per cent; and teaching of English and speech, .6 per cent. It will be noted that more than 75 per cent of the units offered come under original speech and drama. The replies to the Rating Scale indicated that the two most important phases of speech education in the junior college were original speech and drama.

Teacher-training needs evolved from a study of 292 junior college catalogues. The five leading courses in junior college speech education, with number of units offered by 292 junior colleges as a criterion are: "Public Speaking," "Play Production," "Argumentation and Debate," "Interpretation of Literature," and "Principles of Public Speaking." Inasmuch as these courses have not only a generalized, but also a specialized aspect, it will be necessary for the prospective junior college teacher of speech to take advanced work in debate and drama, preferably on the upper-division and graduate levels.

Emphasis in Speech Education Curricula as Found in Textbooks

Thus far there have been presented analysis of typical courses of study and of speech education offerings found in a catalogue study of numerous institutions of secondary and junior college rank. It is the purpose of the present section to make a careful examination of the emphasis placed upon various phases of speech education as set forth in textbooks.

In order to determine which were the five leading texts in each field of speech education, the total for all six columns was used as a means of ranking. The five leading texts in each field, selected on the basis mentioned, are given in Table III.

The leading topics are listed below with the percentage of space allotment in the five texts studied:

Topic	Percentage of Space Allotment	Topic	Percentage of Space Allotment
General Speech Education		Original Speech	
Original speech	20.8	Debating	27.7
Voice	13.1	Original Speech	18.7
Speech Science		Drama	
Major speech defects	23.9	Texts of plays (dialogue)	57.5
Speech sounds	18.8	Director's problems	10.4
Interpretation			
Selections	31.1		
Voice and diction	7.1		

The relative importance of significant topics or work units of the three levels of secondary speech education. In order to determine the relative importance of significant work units in the field of speech, from the point of view of the teacher of speech, a chart entitled "Evaluation of School Speech Problems" was devised. The topics

TABLE III

THE FIVE TEXTBOOKS IN EACH SUBJECT FIELD RECEIVING HIGHEST NUMBER OF MENTIONS BY COLLEGIATE AND SECONDARY INSTRUCTORS

AUTHOR	NAME OF TEXTBOOK	NO. MENTIONS
GENERAL		
*Craig	The Speech Arts	93
*Woolbert	The Fundamentals of Speech	92
*O'Neill and Weaver	The Elements of Speech	71
Gough	Effective Speech	47
*Bassett	Handbook of Oral English	46
SPEECH SCIENCE		
Borden and Busse	Speech Correction	55
Travis	Speech Pathology	40
Pillsbury and Meader	The Psychology of Language	31
Greene	Cause and Cure of Speech Disorders	27
†McLean	Good American Speech	5
INTERPRETATION		
Woolbert and Nelson	Art of Interpretative Speech	82
Johnson	Modern Literature for Oral Interpretation	79
*Craig	The Speech Arts	
Johnson	Dialects for Interpretation	50
*Bassett	A Handbook of Oral Reading	42
ORIGINAL SPEECH		
Woolbert and Weaver	Better Speech	109
*Woolbert	Fundamentals of Speech	66
Baird	Public Discussion and Debate	62
*O'Neill and Weaver	The Elements of Speech	58
Immel and Whipple	Debating for High Schools	57
DRAMA		
Dolman	The Art of Play Production	83
Dickinson	The Chief Contemporary Dramatists	65
Cohen	One-Act Plays	64
Andrews and Weirick	Acting and Play Production	62
Mayorga	Representative One-Act Plays—American Authors	60

* Duplications within list. † Not in Rating Scale list.

selected for evaluation were chosen because a considerable number of pages were devoted to them in the texts analyzed.

The Evaluation Charts were filled out by thirty-three experienced teachers or graduate students, twenty-two at the University of Wisconsin and twelve at the University of Southern California. Each person was asked to rate the topics listed in terms of per cent according to their relative importance at the three levels of secondary

education. In order that the principal topics for each level might be more clearly indicated, a separate listing was made of the five leading topics for each of the secondary levels. This is shown in the following abstract:

Ranking	Activity	Field of Speech	Percentage of Emphasis
		Junior High School	
1	Bodily Expression (Pantomime; all fields)		9.59
2	Conversation (Original speech)		7.56
3	Voice and Diction (Interpretation and Drama)		7.39
4	Original Speech (Original speech)		7.20
5	Speech Defects (Speech Science)		6.76
		Senior High School	
1	Original Speech (Original speech)		7.31
2	Conversation (Original speech)		7.20
3	Bodily Expression (Pantomime; all fields)		7.19
4	Voice and Diction (Interpretation and Drama)		7.03
5	Play selections, longer plays (Drama)		6.93
		Junior Colleges	
1	Voice and Diction (Interpretation and Drama)		6.75
2	Debating (Original speech)		6.57
3	Authors and Plays (Drama)		6.37
4	Conversation (Original speech)		6.36
5	Original speech (Original speech)		6.27

The Present Status of Teacher Training in Speech in the United States

Before submitting the data obtained from the returns of the rating scale, it is appropriate to present such facts as are available concerning the respondents to the scale and the schools which they represent. Seventy-seven collegiate institutions and eighty-one secondary institutions, or a total of 158 institutions are represented by the respondents to the rating scale.

Significant findings from this portion of the study are quoted:

> Interesting data on the training and experience of seventy secondary school instructors were derived from the compilation of data from the blank entitled, "Statement of Training and Experience." The summary (Table II) shows that the median year for the first degree was 1922 and for the highest degree, 1928. Of the instructors studied, thirty-one or 53 per cent, held the A.B. degree; nineteen held the M.A. degree, or 33 per cent; and only three, or 5 per cent, held the Ph.D. degree. The professional attitude of the respondents is shown by the fact that twenty-three reported graduate work taken in summer school, while eight reported work taken during the regular session.
>
> The collegiate majors and minors of these instructors are both interesting and significant. The greatest number, thirty-six, or 47 per cent, had majors in speech, while twenty-nine, or 38 per cent, had majors in English. Their minor

subjects were: speech, twenty-five, or 29 per cent; social science, twenty-one, or 24 per cent; languages, fourteen, or 16 per cent; and English, twelve, or 14 per cent. Collegiate activities engaged in by these teachers were: debate by 14, or 40 per cent, and drama by 13, or 37 per cent, again showing the importance of these two phases of speech education. Oratory ranked third, with six teachers, or 17 per cent engaged in that activity.

Under the caption, "Subjects Actually Taught While Employed as a Teacher," speech again heads the list, with ninety-eight various combinations covering the fields of speech education. Thirty-four taught English; eleven, language; and eleven, social science. The range of years taught was from one to thirty-five, with a mean of twelve years. It can be said therefore that the group of teachers responding to the rating scale was an experienced group.

Somewhat similar material was gathered concerning the training and experience of junior college instructors through a study of one hundred catalogues. It showed that in 95 per cent of these institutions no more than two instructors are employed to handle instruction in speech. The most common subject combinations in the teacher's program are: different phases of speech work, 100; English, 32; and English and speech, 24. The Master of Arts degree was held by 48 per cent of the teachers and the Bachelor of Arts degree by 47 per cent. Thirty-four teachers had taken graduate work and seven had had professional experience. A study of the experience of these instructors shows the range of teaching experience to be from two to thirty-five years, with a median of approximately ten years.

The Training in Education Afforded the Secondary School Teacher of Speech

In the rating scale under the heading of "practice teaching" the respondents were asked to indicate their preferences for different types of practice teaching and also to indicate the strengths and weaknesses of the teacher-training program. A tabulation of the opinions of secondary and collegiate instructors agreed that the combination of observation and demonstration with actual teaching was the best method. According to Table IV one notes that the collegiate instructors were much more emphatic in their stamp of approval on the combination type of practice teaching than were the secondary instructors; that is, 64 per cent of the respondents from colleges and universities thought this method the best, while 42 per cent of the secondary instructors approved it.

The other types approved were actual teaching and observation and demonstration, in the order mentioned. The secondary school and college instructors show marked agreement in indicating the strength of the teacher-training program. More than half of each group stated that adequate facilities and equipment constituted the greatest strength, while 14 per cent of the secondary instructors and 19 per

cent of the college instructors thought that adequate training school administration was the greatest strength of the training profession that college instructors added more ideas concerning the teacher-training program than did the secondary school instructors. Certain items, however, will be called to the attention of the reader. For example, under type of practice teaching, the last item recorded, "not needed," is evidently a remnant of the old philosophy that if a person knew a subject, he knew how to teach it. Under the "strengths of the teacher-training program," a number of valuable suggestions, such as "selection of superior students," and "cooperation with other de-

TABLE IV

OPINIONS OF SECONDARY AND COLLEGIATE INSTRUCTORS WITH REGARD TO TYPES OF PRACTICE TEACHING AND STRENGTHS, WEAKNESSES OF TRAINING PROGRAM

ITEM	SECONDARY INSTRUCTORS NUMBER	SECONDARY INSTRUCTORS PER CENT	COLLEGIATE INSTRUCTORS NUMBER	COLLEGIATE INSTRUCTORS PER CENT[32]
B. *Practice teaching*				
Combination	32	42.1	43	64.2
Actual teaching	26	34.2	15	22.4
Observation and demonstration	18	23.7	9	13.4
C. *Strengths of teacher-training program*				
Adequate facilities and equipment	20	58.8	23	54.8
Adequate training school administration	14	41.2	19	45.2
D. *Weaknesses of teacher-training program*				
Lack of funds	15	41.7	21	38.2
Small training staff	13	36.1	17	30.9
Poor facilities and equipment	8	22.2	17	30.9

partments" are given. Under Section D, "weaknesses of the teacher-training program," certain other suggestions were made by collegiate instructors; namely, "public schools used as a laboratory," one response; "lack of speech training," two; "no speech methods," one; and the like.

THE WORK IN SPEECH EDUCATION AFFORDED THE SECONDARY SCHOOL TEACHER OF SPEECH

Work offered in speech in the higher institutions of the country is considered under the following headings: (1) course offerings in speech in 507 universities; and (2) the major and minor program.

Course offerings in speech in 507 universities. In this analysis of offerings in speech education in 507 colleges and universities, the

[32] In calculating percentages, the number of teachers who checked alternatives given in the rating scale was used as the base.

scheme devised by Weaver has been used, that is, column 6 in a table or the key number 6 denotes "acting"; 7 denotes "analysis and appreciation of literature and drama"; 8 denotes "argumentation and debate," and the like. The key to the tables presenting the catalogue analysis was given in Chapter VI in the study of the junior college situation. (*Cf.* Page 163—Original Study.) In Table V which presents this classification, the courses under each heading are given in alphabetical order.

It is of interest to the teacher of speech and of especial interest to the student who is preparing for the work to know the relative value of courses in each phase of speech science. In Table VI, therefore, those courses in which a total of more than one hundred units is offered by the 507 institutions are listed in order of importance.

Further discussion of course offerings in speech education in universities is arranged under the following topics: (1) comparison of units taught in the fields of speech education in different sections of the United States; (2) importance of specific speech courses in terms of semester units; and (3) related courses supplementing the work in speech education.

(1) *Comparison of units taught in the fields of speech education in different sections of the United States.* Table V shows the number of units of speech education taught in colleges and universities in different sections of the United States. Out of a gross total of 12,355 units offered, 5,124 units, or 41.5 per cent, may be classified as original speech; 3,190 units, or 25.7 per cent as drama; and 2,049 units, or 16.6 per cent, as interpretation. The lesser offerings occur in the fields of speech science, 909 units, or 7.4 per cent; teaching of English and speech, 767 units, or 6.2 per cent; and miscellaneous, 316 units, or 2.6 per cent. In studying the regional classifications; namely, the central, eastern, southern, and western, it is found that the practice in different sections does not vary markedly from a national norm, in that original speech leads the field in each case with drama second and interpretation third.

This philosophy is in harmony with the "integration" movement which is influencing not only the secondary education system but the colleges as well.

The professional value of specific courses in speech. A considerable portion of this section has been devoted to a catalogue study of the offerings in speech in colleges and universities, and a part of the preceding section to a similar study in 292 junior colleges. These

TABLE V

COURSES OFFERED IN EACH SPEECH FIELD

COURSE	TOTAL UNITS OFFERED IN 507 UNIVERSITIES
SPEECH SCIENCE	
Phonetics	133
Physiology and vocal mechanism	9
Physics of sound	6
Psychology of speech and persuasion	142
Seminar in speech defects	8
Speech correction	198
Speech clinic	37
Speech pathology	16
Voice training and diction	309
Voice and speech science	51
INTERPRETATION	
Dramatic reading and platform art	240
Interpretation of Browning	22
Interpretation of contemporary poetry	45
Interpretation of literature	1027
Interpretation of Tennyson	16
Interpretation of Shakespeare	108
Oral reading (expression)	238
Program building (lyceum, chautauqua, lecture)	152
Seminar in interpretation	40
Story telling	161
ORIGINAL SPEECH	
Argumentation and debate	1389
Business and professional speech	117
Extemporaneous speaking	360
Forms of public address (forum)	244
Intercollegiate debate	172
Orations and oratory	287
Orators (history)	109
Parliamentary law	68
Principles of public speaking (fundamental)	1279
Public speaking (general)	711
Rhetoric and public speaking	51
Seminar in debate	75
Seminar in problems of speech (advanced public speaking)	109
Speech construction and composition	153
DRAMA	
Acting	161
Analysis and appreciation of literature and drama	25
Costume design and makeup	48
Dramatic art	225
Drama (general)	100
Drama (contemporary)	228
Drama (European)	13
History of the theater and drama	243
History of pageant (pageantry)	71
Pantomime	50
Play direction	134
Play production (elementary and advanced)	1455
Play writing	211
Scene and stage design and lighting (stagecraft)	195
Seminar in drama and dramatics	31

TABLE VI

TOTAL NUMBER OF UNITS IN SPEECH COURSES LISTED IN 507 COLLEGE AND UNIVERSITY CATALOGUES

NAME OF COURSE	NUMBER OF UNITS	PER CENT OF TOTAL
Play production (elementary and advanced)	1455	11.78
Argumentation and debate	1389	11.24
Principles of public speaking (fundamentals)	1279	10.35
Interpretation of literature	1027	8.31
Public speaking (general)	711	5.75
Teaching of speech	430	3.48
Extemporaneous speaking	360	2.91
Teaching of English	337	2.73
Voice training and diction	309	2.50
Orations and oratory	287	2.32
Forms of public address	244	1.97
History of the theatre and the drama	243	1.97
Dramatic reading and platform art	240	1.94
Oral reading (expression)	238	1.93
Drama (contemporary)	228	1.85
Dramatic art (general)	225	1.82
Play writing (criticism)	211	1.71
Speech correction (clinic)	198	1.60
Scene and stage design and lighting	195	1.58
Intercollegiate debate	172	1.39
Miscellaneous	163	1.32
Acting	161	1.30
Story telling	161	1.30
Speech construction and composition	153	1.24
Program building (lyceum, chautauqua, lecture, platform)	152	1.23
Psychology of speech and persuasion	142	1.15
Play direction	134	1.08
Phonetics	133	1.08
Business and professional speech	117	.95
Private lessons	116	.94
Seminar problems of speech (advanced public)	109	.88
Orators (history)	109	.88
Interpretation of Shakespeare	108	.87
Drama (general)	100	.81
Seminar in debate	75	.61
History of pageant (pageantry)	71	.57
Parliamentary law	68	.55
Voice and speech science	51	.44
Rhetoric and public speaking	51	.41
Pantomime	50	.40
Costume design and makeup	48	.39
Interpretation of contemporary poetry	45	.36
Seminar in interpretation	40	.32
Research	37	.30
Speech clinic	37	.30
Seminar in drama and dramatics	31	.25
Analysis and appreciation of literature and drama	25	.20
Interpretation of Browning	22	.18
Interpretation of Tennyson	16	.13
Speech pathology	16	.13
Drama (European)	13	.11
Physiology and vocal mechanism	9	.07
Seminar in speech defects	8	.06
Physics of sound	6	.05
Totals	12,355	100.00
Units per institution	24.37	

tabulations give an index to the relative importance of college courses in speech, using the number of units offered as a criterion. Of importance also is the professional value attributed to the enumerated courses in speech by secondary school teachers of speech. (*Cf.* Table

TABLE VII

PROFESSIONAL VALUE TO SEVENTY SECONDARY TEACHERS OF SPEECH OF UNIVERSITY COURSES IN SPEECH AND RELATED SUBJECTS

SPEECH COURSE	RATING					AVERAGE
	EXCELLENT (2)	GOOD (1)	FAIR (0)	POOR (—1)	NO VALUE (—2)	
Play direction	28	3	1	0	0	1.84
Acting	28	7	4	0	0	1.67
Appreciation of drama	13	7	0	0	0	1.65
Voice and diction	20	8	1	0	0	1.65
Speech correction	9	0	2	0	0	1.64
Pantomime	12	3	2	0	0	1.59
Drama (European)	10	8	0	0	0	1.56
Play production	24	3	4	1	0	1.56
Principles of public speaking	17	10	2	0	0	1.52
Phonetics	17	4	4	0	0	1.52
Oral reading	18	5	2	0	1	1.50
Public speaking (general)	15	12	1	0	1	1.50
Seminar in drama	5	2	1	0	0	1.50
Teaching English	15	4	2	1	0	1.50
Drama (contemporary)	13	8	2	0	0	1.48
Extemporaneous speaking	24	10	4	1	0	1.46
Physiology of voice	12	2	4	0	0	1.44
Forum (public address)	3	4	0	0	0	1.43
Interpretation of contemporary literature	8	4	2	0	0	1.43
Costume and makeup	19	10	3	0	1	1.40
Drama (general)	15	9	1	1	1	1.33
Teaching speech	16	7	2	1	1	1.33
Speech pathology	6	1	3	0	0	1.30
Scene design and lighting	6	1	3	0	0	1.30
History of theater	11	6	3	0	1	1.29
Intercollegiate debating	12	2	1	0	2	1.29
Private lessons	17	6	4	1	1	1.28
Interpretation of literature	14	8	7	0	0	1.24
Story telling	12	3	2	3	0	1.20
Argumentation and debate	17	12	5	1	1	1.19
Parliamentary law	7	2	5	0	0	1.14
Interpretation of Browning	6	6	5	0	0	1.06
Seminar in speech defects	3	0	1	1	0	1.00
Voice and speech science	6	1	2	2	0	1.00
Rhetoric	6	4	5	1	2	.94
Physics of sound	3	1	4	0	0	.88
Seminar in interpretation	2	4	0	0	1	.86
History of pageantry	4	5	2	0	2	.85
Interpretation of Tennyson	2	6	4	0	0	.83
Play writing	4	4	1	1	1	.82
Psychology of speech	7	3	5	1	1	.82
Orations	5	8	2	2	1	.78
Seminar in debate	4	2	0	0	2	.75
Program building	1	1	3	0	0	.60
Orators (history)	1	0	3	1	1	—.16

VII.) The courses were rated on a five-point scale: excellent, good, fair, poor, and no value. In computing mean ratings, these qualifying words were assigned the following algebraic values, respectively: 2, 1, 0, –1, and –2. That is, 2 would be the highest rating obtainable and –2 the lowest.

The ten items ranking highest with their average ratings are as follows: play direction, 1.84; acting, 1.67; appreciation of the drama, 1.65; voice and diction, 1.65; speech correction, 1.64; pantomime, 1.59; European drama, 1.56; play production, 1.56; principles of public speaking, 1.52; phonetics, 1.52. It is interesting to compare two courses which come in the center of the ranked listing: teaching of English, 1.50, and teaching of speech, 1.33. Twenty-seven teachers expressed their opinions on the professional value of the teaching of speech, while twenty-two did so with regard to the teaching of English, giving the latter subject a higher ranking. Inasmuch as these respondents had an average of twelve years experience, it is probable that at the time they took the course in the teaching of speech it was in its infancy and as a consequence not well organized.

The presence of such courses as parliamentary law, orations, debate, program building, and kindred subjects in the lower third of the list probably indicates a lessening emphasis on these subjects; on the other hand, it will be noticed that the three subjects which head the list are all in the field of drama, that is, play direction, acting, and appreciation of drama.

Practice Work in Speech Education

In general, the practice work offered in speech education to prepare the teacher for his work consists of (1) methods courses offered in the university, and (2) extra-curricular work, which is in many cases required of students majoring in speech. The discussion of these two phases of the practical work in speech constitutes the purpose of this section.

Methods courses in speech. A study of column captioned "methods courses in the teaching of English," and of column entitled "methods courses in the teaching of English," in Table X, reveals some interesting facts. Thirty-one states offer the methods courses in speech, while eighteen do not; and thirty-six states offer the methods course in English, while thirteen do not. It is to be noted that only five more states offer the methods courses in English than offer a similar course.

The third section of the chapter was devoted to findings from other studies in regard to speech curricula. Miller contrasts modern curriculum conditions with those under the old three-R curriculum. Koos traces the growth in oral

English as an adjunct to the regular work in English literature and composition. Cortright lists twelve principles upon which the making of a speech curriculum should be based. Smith, in an extensive study of the English curriculum, 156 courses of study in 127 cities, found that the average offerings in speech were 1.5 semesters. Close agreement was found between the findings of Smith's study and the present one. Lyman's study of English offerings in the senior high school provided an interesting list of electives in drama and debating. From Sanders' investigation on the status of dramatics, in which a study was made of 210 schools of the North Central Association, data on grade placement of courses in dramatics were obtained, which showed a tendency to offer the work in the eleventh and twelfth grades.

The respondents were asked to report on the actual and recommended allotments of time for the five phases of speech education at the three secondary levels. With regard to work at the junior high school level, secondary instructors advocated that less time be given to a speech education in English and other related courses and that such time as is allotted be distributed more evenly among the various phases. Secondary instructors would not change materially the time allotments for the various phases of the work in the regular junior high school speech courses. The reports of secondary instructors indicate that the speech content of the senior high school English curriculum consists chiefly of original speech, offered for 20.9 weeks, and drama, offered for 32.1 weeks. In regular high school speech courses the following three phases are allotted more than one semester of time: foundational work, offered 20.1 weeks; original speech, allotted 22.5 weeks; and drama, assigned 24.3 weeks. Secondary and college instructors concur in the opinion that more than one semester of time should be devoted to interpretation, original speech, and drama in junior college speech courses. Findings reveal a more general agreement between actual and recommended practice in the junior college than was found at the other two levels of instruction.

The range in number of units of methods courses in speech offered in a single state ranged from two to thirty-three with a mean of 10.87 units; the number of units offered by different states in methods courses in English ranged from two to fifty-five, with a mean of 11.94. The offerings in the state of Ohio were the most generous to both fields, thirty-three units in speech methods and fifty-five in the teaching of English. Other states offering twenty or more units in the field of methods in the teaching of speech or teaching of English and consequently those making generous provisions for professional advancement in these fields are: California, Illinois, Indiana, Iowa, New York, Ohio, Texas, and Wisconsin.

A more adequate idea of the offerings in methods courses in

speech by the twenty universities granting graduate degrees is gained through a study of their catalogues and by excerpting from them a description of methods courses than through a tabulation of the data secured. A representative sample is the description of Education 261-b from the Teachers College, Columbia University, catalogue. The title of the course is Teaching of Speech for Secondary Schools.[33] The following description reveals the nature of the course:

> The study of the nature and use of various exercises in secondary schools; reading and reports of current experiments and methods; practice in the class with discussion of specific problems in teaching oral composition debate, public speaking, voice, phonetics, and educational dramatics.

The mean number of such methods courses offered in the twenty institutions granting graduate degrees in speech is 1.6.

The titles of these methods courses are significant of their content. In most cases, a two- or three-sentence description accompanied the title in the university catalogue. The titles are: Practice Teaching in Dramatic Work, Speech Education in the Elementary School, Teaching of Speech for Secondary Schools, Teaching of Voice and Diction, Phonetics for Teachers, Problems in Speech Education and so forth. Table XIII gives significant data regarding teacher training courses offered in the 507 universities studied.

In-Service Training by School Agencies of Supervision

The fact that there are seldom more than two instructors in speech in the average secondary school makes creative supervision for teachers of speech particularly necessary. In the survey of one hundred junior college instructors, it was found that 95 per cent of this group worked in colleges with two or fewer instructors in speech. California in 1932–33 had 389 senior high schools with but sixty-two full-time teachers of speech, or .16 teacher per school; there were 255 part-time teachers of speech, or .65 teacher per school; the total number of speech teachers in California was 316, or .81 teacher per school.

The dearth of materials dealing with supervision in the high school is a well-known fact among educators. A quotation from Laughlin[34] shows the existing condition:

> The technique of high school supervision has not been thoroughly worked out. School systems have experimented with heads of departments, subject sup-

[33] Columbia University, *Teachers College Bulletin*, N. Y. City: Columbia University Press, 1932, p. 132.

[34] *Second Yearbook*, Education Committee, Chicago Principals Club, June, 1927, p. 105.

ervisors, district superintendents, etc., but as yet no one has any definite recommendations. If one examines the literature on high school supervision he will find it very scanty. Many good books on elementary supervision have appeared during the last few years, but the high school field is practically untouched.

TABLE VIII

TOTAL NUMBER OF STATES OFFERING AND NOT OFFERING METHODS COURSES IN SPEECH AND METHODS COURSES IN ENGLISH
(From a survey of 507 Catalogues)

METHODS COURSES IN THE TEACHING OF SPEECH	
Number of states not offering	18
Number of states offering	31
Range in units offered	2–33
Mean number of units	10.87
Total number of units offered in the United States	337
METHODS COURSES IN THE TEACHING OF ENGLISH	
Number of states not offering	13
Number of states offering	36
Range in units offered	2–55
Mean number of units	11.94
Total number of units offered in the United States	430
Number of states having neither a methods course in the teaching of English nor one in the teaching of speech	10

One of the most extensive and objective studies on supervision of instruction in high school was made by Hughes and Melby.[35] The results were validated by questionnaires and by interviews with 357 teachers of social science and 385 administrators and specialists. While the particular methods of social science were studied, the general aspect and organization of supervision in high school was discussed.

The five types of school supervision and organization are shown in diagrammatic scheme in one section of the book.[36] The first type is the simple one in which the teacher is supervised by the principal and by the superintendent as well. The second is the departmental organization type in which the teacher is directly supervised by the head of the department who in turn is supervised oy the principal. The third type is the type in which the teacher is subject to the supervision of as many as three officials; the department head, the principal, and the superintendent. The fourth type is the cabinet type of organization effective in large high schools. The school is administered

[35] Hughes, James Monroe, and Melby, E. O., *Supervision of Instruction in High School,* Bloomington, Ill.; Public School Pub. Co., 1930.

[36] Hughes, J. M., and Melby, E. O., *op. cit.,* pp. 13 ff.

through the principal's cabinet of eight members who administer departments in groups. It is this system which is used in the Los Angeles City Schools at the present time to take care of duties formerly administered in each high school by twelve to fifteen department heads. A fifth and also one of the newer types of organization is that of having a supervisor of instruction in all subjects. This type of supervision is well exemplified in the work done by William J. Klopp[37] in Long Beach.

As previously stated, it is not the function of this section to point out the "best type of supervision" but merely to show the types of organization which exist.

An important finding of Hughes and Melby is that such traditional activities are employed and also many of the most recent developments.[38] It is not possible to present here the extensive objective data which these investigators have gathered; however, certain characteristics of the old and new supervision will be listed. The characteristics of the older type of supervision are:[39]

1. Classroom visitation by supervisory officer
2. Conference of supervisor and teacher
3. Demonstration teaching
4. Inter-visitation of teachers
5. Group meetings of teachers with supervisor
6. Miscellaneous devices for promoting professional advancement
7. Activities in connection with the curriculum
8. Research activities

The newer type of supervision, as characterized by the authors, abolishes much of the formal type of supervisory procedure, such as visitation and conferences. Characteristics of the new supervision are:[40]

1. Teachers engage in many individual and group activities, the purpose of which is to improve teaching.

[37] Klopp, William J., "The Function of the Director of Teaching in the Secondary School," *High School Teacher*, 5, April, 1929, 142; "Releasing the Creative Power of Teachers." *American School Board Journal*, 85, July, 1932, 31–32.

[38] *Ibid.*, Chapter III, "The Traditional Activities Employed"; Chapter IV, "Newer Activities Employed."

[39] *Ibid.*, p. 32.

[40] *Ibid.*, p. 7.

2. Teachers make special investigations comparing units of courses of study, devising new tests, constructing work sheets for pupils, or carrying out projects in the selection of reference material.
3. Leadership in these activities of teachers appears to be a promising field for high school supervision.

These principles all show that "the newer point of view emphasizes strongly the principle of teacher growth."[41] If teacher growth is the aim of supervision, then it is maintained that supervision should be so organized and conducted as to promote teacher initiative, self-direction, and self-expression. This contention is supported by quotations from Spain, Courtis, Kilpatrick, and Bobbitt.

The greatest single contribution made by Hughes and Melby is the chapter "Improvement of Instruction through Activity Analysis." A brief summary of their activity analysis is given:[42]

1. Kinds of teaching activities used and the frequency of use
2. The duration of each kind of activity
3. The variation in kind, number, and length of activities as found in the different classes
4. The distribution of activities among the different pupils in the various classes
5. The relationship between number and kind of activity and the ability and achievement levels of the pupils performing them
6. The distribution of the kind and number of activities during the different phases of the recitation
7. The division of class participation between teachers and pupils and entire class or groups within the class

The means which the authors advise for carrying out this type of activity analysis are shown in charts which give in detail teacher-, class-, and pupil-activities. These charts show the duration of single activities, the division of time of activities between pupil and teacher, and other aspects of actual classroom teaching.

In order to examine the functions of the various officials of the school system in supervision of in-service training, the duties of each of the following will be treated in summary form: (1) the supervisor; (2) the principal; (3) the department head.

The part of the superintendent in in-service training. In making a list of the most important duties of the city superintendent of schools, Whitney uses the composite ranking of one hundred experts. Eleven, or exactly one-half of the twenty-two duties listed, have to do directly with the teacher.

[41] Hughes and Melby, *op. cit.*
[42] *Ibid.*, pp. 151, ff.

The four items which ranked highest in the list have to do with the superintendent's relation to the teacher. They are:

1. To recommend the appointment, transfer, and dismissal of teachers
2. To study the qualifications of school men and women and to recommend for appointment
3. To furnish understanding and leadership of education among the teachers and citizens
4. To supervise and participate in meetings and conferences of members of the supervising and teaching staff; to maintain inspiration and enthusiasm for the service.[43]

The supervisor, Perusal of *Patterson's Directory of Schools and Colleges in the United States for 1932–33,* failed to reveal any city supervisors of speech. The travels and studies of the present investigator, however, have revealed that in the city of Oakland, California, Doris E. McIntyre is supervisor of drama and English, and that Clarence E. Stratton is supervisor of English in the city of Cleveland, Ohio.

The field of speech correction is more controlled by supervisory agencies than is the field of speech education. A survey of Murray[44] of eighty-six school systems revealed that twenty-nine had departments of corrective speech. Employed in this work were 130 full-time teachers and 148 part-time teachers. This work is carried on in forty different institutions in twenty-nine cities.[45]

The principal. The duties of the principal are admirably summarized by Laughlin in his list of the duties in regard to supervision.[46] The duties are discussed by Cubberley[47] under these main headings: knowing the school, classifying and promoting pupils, obtaining results from course of study, special teachers and their work, planning the supervision, helping the teacher, measuring instruction, and making teachers' meetings profitable.

The department head. Inasmuch as the department head has the closest contact with the teacher in service, this phase of supervision commands a somewhat lengthier treatment than that given the other phases.

One of the most extensive objective studies on the duties of the department head was made by Douglass.[48]

A study by Sanders [49] on the supervision of dramatics in the 210 schools of the North Central Association showed that in 43.3 per cent

[43] *Ibid.*, p. 205.

[44] Murray, James, "The Status of Corrective Speech Instruction in the Public Schools of the U. S.," unpublished Master's Thesis, University of Southern California, Los Angeles, California, 1930, pp. 22–23.

[45] *Ibid.*, p. 18.

[46] *Second Yearbook,* Chicago Principals' Club, *loc. cit.*

[47] Cubberley, Elwood P., "The Principal and His School," Riverside Educational Series, Boston: Houghton Mifflin Co., 1923, p. 337.

[48] Douglass, R. H., "Department Heads and Chairmen in Senior High Schools," unpublished Master's Thesis, University of Southern California, Los Angeles, California, 1928, 142 pp.

[49] Dye, Maxine, "A Survey of Speech Organizations in the U. S.," unpublished Master's Thesis, University of Wisconsin, 1930.

of the cases, dramatics was supervised by the English department and in 28.4 per cent, by speech departments.[50] The supervision of dramatics in public speaking, dramatics, and other departments was relatively rare. In regard to the practice in departments in schools of 500 enrollment and below, it is noted that in thirty-one schools, the supervision is under the department of English, and in sixteen, under speech.

Dye[51] has gathered available information on 226 organizations, contests, and leagues with speech interests. The information, obtained largely through the questionnaire method, was grouped under these headings: name, officer, membership, purpose of organization, short summary of constitution, publication, and remarks. As an example, the information given on the Alabama Dramatic Tournament is cited:

Name of organization: Alabama Dramatic Tournament.

Officers: Held under auspices of Extension Division of Alabama Polytechnic Institute, Auburn, Alabama.

Membership:

(1) Requirements for: high schools.

(2) Present roster: approximately 15.

Purpose of organization: Each high school puts on a play for contest. To furnish a wholesome spirit in field of dramatic literature and art.

Short summary of constitution:

(1) Number of meetings a year: one.

(2) Place of meetings: Auburn, Alabama.

(3) Time of meetings: Spring.

Training affected by committees and by survey work. Dye divides the speech organizations into those which are interested in speech in general and those interested in speech in the individual. The important data concerning these groups of speech organizations are given below.[52]

TEACHERS CONFERENCES	TOTAL NUMBER
STATE	
Speech divisions of state teachers associations	22
Drama teachers associations	1
Speech correction associations	3
Coaches conferences	13
SECTIONAL	
Eastern Public Speaking Conference	11
Southern Association, Teachers of Speech	17
Western Association, Teachers of Speech	11

[50] These figures given in Table LXXII of the original thesis manuscript, p. 342, show the interrelationship of English and Oral English departments.

[51] *Ibid.*, p. 67.

[52] *Ibid.*, p. 18.

ORGANIZATIONS INTERESTED IN SPEECH IN THE INDIVIDUAL

COLLEGE	
State leagues	23
Extemporaneous speaking contests	12
Interpretation contests	4
Oratorical contests	26
Play contests	8
Forensic contests	2
Dramatic contests	6
Debate	9
Oratory	9
HIGH SCHOOL	
Debate	41
Declamatory contests	24
Extemporaneous speaking contests	17

Teachers of Speech is that type of fraternal organization which influence professional growth through meetings and publications. According to Nichols, there are "447 chapters of these fraternal organizations actively maintained in 353 different institutions of higher learning." There are 593 colleges listed in the 1932 issue of the World Almanac. From this figure it is seen that fraternal organizations in the field of speech are established in more than half of the colleges. A complete list of fraternal organizations, with place and date of foundation is given by Cable.[53] Of the fraternities listed, eleven issue publications.

State and local organizations. The Dye[54] study shows the location of the teachers' associations, high school associations, and college associations in speech. The general impression is gained that each state has several organizations in the field of speech education. The poorest representation is in the Rocky Mountain area which of course is more sparsely settled than other parts of the country. Dye[55] also in a survey of speech organizations, recognizes the importance of eighteen professional magazines by devoting a section of her thesis to their consideration.

The National Association of Teachers of Speech holds an annual convention, the most important event in the year in speech education, at some metropolitan city decided upon by the executive committee. In addition to the National convention, an annual meeting is held by each of the four regional groups under the national organization. A list of topics discussed at the 1936 St. Louis convention are suggestive of the activities of the national as well as of the sectional groups. These were as follows: adult education, speech education in elemen-

[53] Cable, W. Arthur, "A Program of Speech Education in a Democracy," Boston: The Expression Co., 1931, p. 555.

[54] Dye, Maxine, *op. cit.*, p. 17.

[55] *Ibid.*, pp. 140–151.

tary schools, speech education in junior colleges, debate, problems of college administration, dramatic luncheons, national theater conferences, speech education in teachers colleges, speech education in secondary schools, public speaking, drama, interpretation, phonetics, the university theater, rhetoric, group activities for children, conference debate, and the like. Each of these topics was discussed by national authorities in the particular field.

Another activity of this organization is the publication of the *Quarterly Journal of Speech.* The work of publication is supervised by an editor, six associate editors, and four advisory editors, each an authority in his field.

Professional magazines. Professional magazines play an important part in the in-service growth of teachers in its ramifications.

A means of carrying on the work of the organization in addition to the executive committee, is that of fourteen standing committees. The names of the committees suggest their activities: Relations with the National Council of Teachers of English, Debating, Intercollegiate Debating, Oratorical Contests, Regional Associations, Voice and Diction Awards, Radio Speaking, Speech Bibliographies, The Ranking of Speech in Schools and Colleges, Speech Education in Elementary Schools, Speech Education in Junior Colleges, Speech Education in Secondary Schools, Speech Education in Teachers Colleges and Normal Schools, and Speech Education in Technical Schools.[56] Reports of the work of committees as well as the national convention of sectional organizations appear under "News and Notes" in each issue of the *Quarterly Journal of Speech.* Most prominent in the field of speech is the Committee for the Advancement of Speech in Secondary Schools. The first important work of this committee was the Drummond report[57] published in 1925. Later publications included the *Speech Bulletins.*[58] Service on local and state committees which are working on various problems related to speech would be a stimulation to professional growth.

Membership in a national or local survey committee has a potent influence on teacher growth; the results of such work also have an

[56] *Program,* National Association of Teachers of Speech, St. Louis, Missouri, 1936.

[57] Drummond, A. M., *A Course of Study in Speech Training and Public Speaking for Secondary Schools,* New York: The Century Company, 1925, 291 pp.

[58] Cortright, Rupert, editor, *Speech Bulletins,* Supplement to *Quarterly Journal of Speech,* 1928–32.

influence on the advancement of Speech training. On a national scale, the example of the Smith Monograph, a part of the national survey of secondary education, under the direction of Leonard V. Koos[59] may be cited:

As an example of a state committee is the California state superintendent's committee under the direction of Vierling Kersey. The committee is inquiring minutely into the problem of tenth year speech or sophomore English. The committee reported a curriculum in speech for secondary schools at the national convention of the National Association of Teachers of Speech in New York City, December 25, 1933. Speech in Education[60] contains recent materials of significant import and views speech from Gestalt and organismic standpoints.

Training Effected by Advanced Work at Universities and Professional Schools

Numerous references have been made to the twenty institutions offering the higher degrees in speech, that is, the Master's or Doctor of Philosophy degree. An analysis of the course offerings of the regular and summer sessions of these twenty institutions should prove an indication of the work available to the professionally minded instructor in speech. The Weaver[61] study listed seventeen such universities. The three which have been added since 1931 are: Teachers College, Columbia University, New York City; University of Louisiana, Baton Rouge, Louisiana; and the School of Fine Arts, Yale, New Haven, Connecticut. Teachers College, Columbia University, and the University of Louisiana offer both the Master's and Doctor's degrees in speech, and Yale University grants the Master of Fine Arts (M.F.A.), normally obtained by two years study beyond the bachelor's degree.

[59] Smith, Dora V., *Instruction in English*, English Monograph No. 20, National Survey of Secondary Education, United States Department of the Interior, Bureau of Education, 1923, 89 pp.

[60] Vocha Fiske, Editor, *Speech in Education* (to be published in the Fall of 1937, by the California State Department of Education, Sacramento, California). The result of an extensive survey of recent works in all phases of speech. *Cf.* also Sub-Reports compiled by W. P. A. Speech Project No. 1448 on: "Tests, Radio Scripts, Communication, Verse Speaking, Activity Units and Creative Self-expression"; address J. Richard Bietry, 735 Western Avenue, Los Angeles, California. 50c each.

[61] Weaver, J. Clark, "A Survey of Speech Curricula," *Quarterly Journal of Speech*, 18, November, 1932, 607–615.

Further examination of the speech work offered in the twenty universities granting higher degrees in that field will be considered under the following topics: (1) specific courses offered in speech; and (2) relative emphasis on different phases of speech.

(1) *Specific courses offered in speech.* As in the case of the catalogue study of 507 universities, the offerings of each institution were classified under fifty-three specific courses in speech. The offerings in the regular sessions are shown in column 3 of Table IX and the offerings for the summer session in column 4. The totals are given in column 5, and the list of courses is arranged in order of rank by total number of units offered, beginning with "Play Production," 291, and "Interpretation of literature," 158. In general the summer session offerings corresponded in amount to the offerings of the regular session. It is noted, however, in the lower half of the table the occurrence of zeros in the summer session column, indicating that courses of lesser importance are not offered at any institution during the summer session. Rated according to the total number of units offered, the ten most important courses offered are: Play Production, 291 units; Interpretation of Literature, 158; Argumentation and Debate, 127; Scenery, Stage Design and Lighting, 124; Teaching of Speech, 102; Seminar in Speech Pathology, 97; Principles of Public Speaking, 95; Phonetics, 77; Seminar in Drama and Dramatics, 71; Voice Training and Diction, 70.

An analysis of the ten leading subjects reveals that drama and interpretation are implied in three items, original speech and speech science in two of the items, and the teaching of speech in one item. Teaching of Speech was placed fifth in the list, with a total of 102 units offered, while Teaching of English was placed toward the end of the list, with a total of only thirteen units offered.

(2) *Relative emphasis on different phases of speech.* In order to ascertain gross points of emphasis, the fifty-three courses listed in Table X have been classified under the five phases of speech education. Drama and original speech stand out far above the others in the number of units offered in these twenty universities.

It is interesting to compare these emphases with those in the 507 colleges and universities studied. There the chief emphasis comes on original speech with drama second. The other branches of speech education in order of total number of units offered are: speech science, 411 units, or 18.8 per cent; interpretation, 290 units, or 13.3 per cent; the teaching of speech and English, 115 units, or 5.3 per cent.

TABLE IX

SPECIFIC COURSES IN SPEECH OFFERED BY THE TWENTY UNIVERSITIES OFFERING HIGHER DEGREES IN SPEECH

COURSE	UNITS OFFERED IN REGULAR SESSION	UNITS OFFERED IN SUMMER SESSION	TOTAL UNITS
Play production (elementary and advanced)	216	75	291
Interpretation of literature	128	30	158
Argumentation and debate	109	18	127
Scene and stage design and lighting	93	31	124
Teaching of speech	72	30	102
Seminar in speech defects; speech pathology	68	29	97
Principles of public speaking (fundamentals)	79	16	95
Phonetics	56	21	77
Seminar in drama and dramatics	53	18	71
Voice training and diction	48	22	70
Play direction	58	8	66
Play writing (criticism)	58	0	58
Psychology of speech and persuasion	46	9	55
Seminar in debate and rhetoric	44	10	54
Speech correction, clinic	36	18	54
Public speaking (general)	26	22	48
Research (thesis)	41	4	45
Seminar in problems of speech advanced public speaking	35	7	42
Extemporaneous speaking	35	4	39
Forms of public address (forum)	35	4	39
Professional speech	33	5	38
Program building (lyceum, chautauqua, lecture)	33	5	38
Speech pathology	24	12	36
Orators (history)	32	0	32
Orations and oratory	26	8	34
Private lessons	31	0	31
Speech construction and composition	30	0	30
History of the theater	29	0	29
Seminar in interpretation	24	3	27
Acting	26	0	26
Oral reading (expression)	25	0	25
Physiology and vocal mechanism	19	5	24
Costume design and makeup	17	7	24
Drama (contemporary)	18	5	23
Intercollegiate debate	21	2	23
Voice and speech science	15	8	23
Interpretation of Shakespeare	17	0	17
Radio	6	11	17
Drama (general)	16	0	16
Speech clinic	14	0	14
Story telling	11	3	14
Teaching of English	8	5	13
Parliamentary law	10	2	12
Physics of sound	11	0	11
Miscellaneous	10	0	10
Dramatic reading and platform art	4	2	6
History of pageant (pageantry)	4	0	4
Pantomime	4	0	4
Interpretation of Browning	3	0	3
Drama (European)	2	0	2
Interpretation of contemporary poetry	2	0	2
Rhetoric and public speaking	2	0	2
Analysis and appreciation of literature	0	0	0
Dramatic art (general)	0	0	0
Interpretation of Tennyson	0	0	0

One of the most important tables in the study (Table X, below) sets forth a comparison of the percentages of emphasis on the five phases of speech education in the 507 colleges and universities representing the general practice throughout the country and the twenty universities offering graduate degrees in speech. The figures show that in the field of speech science, the percentage of emphasis of 11.4 per cent greater in the twenty institutions than it is in the 507. In the field of interpretation, the emphasis is 3.3 per cent less, and in the field of original speech 13.4 per cent less in the institutions granting graduate degrees. Drama is given a significantly greater percentage of emphasis in the group of twenty institutions—5 per cent greater.

TABLE X

A Comparison of the Percentages of Emphasis on the Five Fields of Speech Education

(Based on total numbers of units offered by 507 universities and teachers colleges of the United States and by the twenty universities granting graduate degrees in speech)

Phase of Speech Education	Percentage of Emphasis in:		Difference in Percentage*
	507 Universities	Universities Granting Graduate Degrees	
(1)	(2)	(3)	(4)
Speech science	7.4	18.8	+11.4
Interpretation	16.6	13.3	—3.3
Original speech	41.5	28.1	—13.4
Drama	25.7	30.6	+4.9
Teaching of speech and English	6.2	5.3	—.9
Miscellaneous†	2.6	3.9	+1.3

* Percentage by which figure in column 3 exceeds figure in column 2.

† This classification is added for purposes of statistical completeness and is not considered a separate branch of speech education.

Evaluation of the Established Program by Authorities in Speech Education

The program outlined, together with the questions on in-service training were included in a letter which was sent to seventy authorities in speech education. Forty replies were received, twenty of which were authorities in speech education in leading universities, and an equal number were heads of departments of speech and instructors in speech in secondary institutions. Of the twenty respondents in secondary schools, ten were senior high school and ten, junior college instructors.

Evaluation of the program in education. With regard to the program in education, which was based on the ratings as to professional value, of standard courses in education, the respondents agreed, in general, with the allotment of units. For practice teaching (four to six units suggested) the mean allotment by respondents was 4.4 units; for special methods (three to five units suggested) the mean was 3.95 units. For the other subjects, "Technique of Instruction," and "Educational Psychology," the replies agreed, in general, with the maximum set, with 2.9 units for the former subject and 3.05 units for the latter.

Evaluation of the program in speech. With regard to the program in speech, there was close agreement between the number of units recommended in interpretation (four units) and in drama (six units) and the mean recommendation by respondents—4.35 units for interpretation, and 5.6 units for drama. Somewhat less emphasis on original speech was recommended in general by those responding; the average number of units recommended was 8.75, as compared with ten units in the representative program. A marked disagreement was evidenced with the suggestion of two units in speech science; an average of 4.5 units was allotted by respondents. Respondents to the rating scale advocated an increased emphasis on speech science for both the junior high school and senior high school levels.

Recommendations Concerning the Secondary School Speech Curriculum

The findings of the present study concerning the secondary school speech curriculum justify the following recommendations:

1. That the aims of secondary speech education be developed in terms of everyday needs of the normal child; at present there is too much of tendency to technical and specialized work.
2. That the aims for each level of secondary speech education be adapted to the needs and abilities of the child at that particular age and educational level, only a few studies of an objective nature have been made; many more need to be made.
3. That speech work at the junior high school level be closely integrated with instruction in English.
4. That speech work at the senior high school level be coordinated with the work of other departments.
5. That at the junior college and senior high school levels some specialization in the various branches of speech be encouraged.
6. That less emphasis on drama and original speech, and somewhat greater emphasis on speech science would be desirable at the senior high school and junior college levels.

7. That in the formulation of projects, greater stress be placed on conversation, forum, and informal speaking than on the more formal type of discourse.

Recommendations Concerning the Training of the Secondary School Teacher of Speech

The findings of the present study concerning the training of the secondary school teacher of speech justify the following recommendations:

1. That prospective English teachers be required to take some work in speech, and that speech teachers be required to take some English. This plan should be extended to teachers in service, where possible. Instruction in Social Science is highly desirable.

2. That a course in speech correction be required of all prospective teachers of speech in order to provide them with an understanding of the work, as well as of certain elementary procedure for correction.

3. That, since "Special Methods in Speech" was rated as having high value to secondary teachers of speech, such a course be offered in every institution which attempts to prepare students for the teaching of speech in secondary schools; this should be required in the course.

4. That prospective teachers of speech, because of the expense of the subject itself, be encouraged to take a broad cultural program.

5. That more emphasis than is now given be placed on speech science in the training program of the secondary teacher of speech.

6. That supervision of teachers in the first year or two years of teaching be extended by schools of education to improve instruction and to promote professional growth.

7. That, since school agencies of supervision were rated as "ineffective" by the majority of those evaluating the suggested program for the prospective teacher, measures be taken to enable these agencies to serve more effectively the secondary teacher of speech.

8. That the work of the professional organizations be closely coordinated in an effort to improve and make more useful the secondary curriculum in speech.

9. That at least one member of the staff, preferably all, keep in touch with the secondary situation. Several respondents in their letters of evaluation said that "the college teacher is so far removed from the secondary school situation that his help is of little value."

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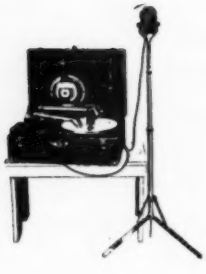

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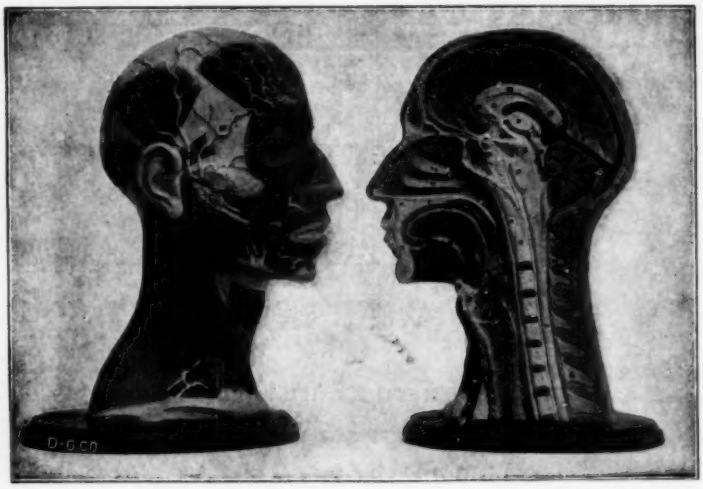

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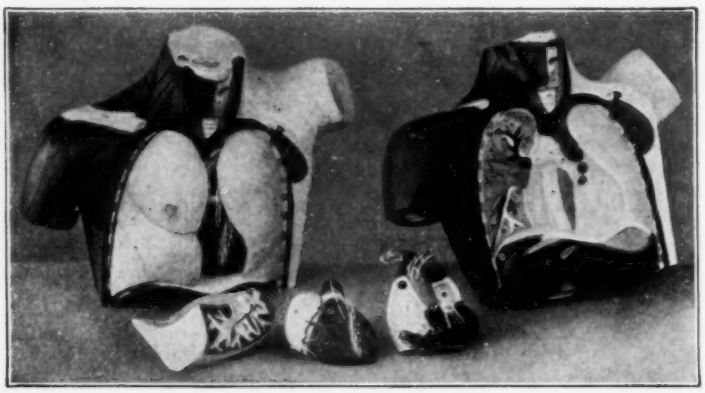

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